JONESPORT HARBOR

MAINE

NAVIGATION IMPROVEMENTS

DESIGN MEMORANDUM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

DECEMBER 1979

NAVIGATION IMPROVEMENTS
JONESPORT HARBOR, MAINE
DESIGN MEMORANDUM
BREAKWATER, CHANNEL AND ANCHORAGES

ERRATA SHEET

8 JANUARY 1980

1. Pg. 7, subparagraph 13c., line 13: "by" should read "from"
2. Pg. 10, 2nd paragraph, line 11; "Maine" should read "Marine"
3. Plate No. 2, Notes; In the last line "7-Foot" should read "8-Foot"
4. Pg. i, Index-Appendices; substitute the inclosed page i.
5. Pg. A-7, lines b(2)(a) and (b)(3)(a); "2.48" should read "3.33"
6. Appendix C, Letters of Comment; Add the inclosed pages 11 and 11a.

2 Incl (14 cy ea)
as

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED-D

13 December 1979

SUBJECT: Navigation Improvements, Jonesport Harbor, Maine
Combined Phase I and Phase II Design Memorandum

HQDA (DAEN-CWE-B)
WASH DC 20314

1. Submitted herewith in accordance with ER 1110-2-1150 are fourteen (14) copies of the subject design memorandum for review and approval.

2. References:

a. NED letter to HQDA (DAEN-CWP-E) dated 3 October 1977, subject: "Waiver of Phase I - GDM Requirement for Jonesport Harbor Authorized Navigation Project".

b. 1st Indorsement to above-referenced letter from DAEN-CWP-E dated 3 November 1977.

3. A copy of the Final Environmental Impact Statement, dated August 1973, was filed with the President's Council on Environmental Quality 14 April 1976. A new statement is not considered necessary as the project description has not changed since that time. Environmental effects, in fact, will be less because 24,700 cubic yards will be removed from the breakwater site in lieu of the 90,000 cubic yards originally scheduled for removal.

FOR THE DIVISION ENGINEER:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

Incl (14 cys)
Design Memo

JONESPORT HARBOR
MAINE

NAVIGATION IMPROVEMENTS

DESIGN MEMORANDUM

BREAKWATER, CHANNEL AND ANCHORAGES

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

DECEMBER, 1979

NAVIGATION IMPROVEMENTS
JONESPORT HARBOR, MAINE
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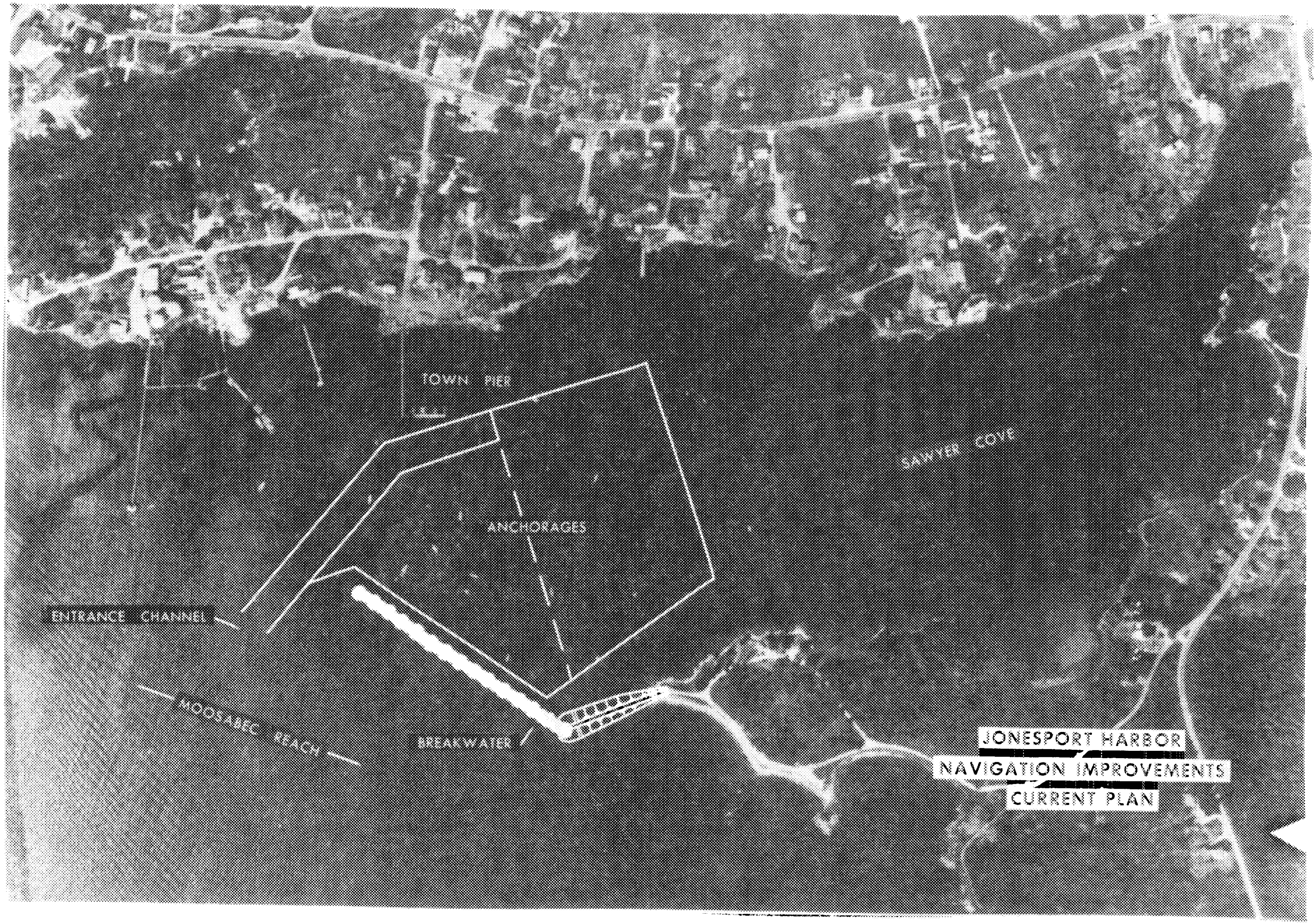
CONTENTS

LIST OF TABLES

LIST OF PLATES

APPENDICES


TOWN PIER
SAWYER COVE
ANCHORAGES
ENTRANCE CHANNEL
MOOSABEC REACH
BREAKWATER
JONESPORT HARBOR
NAVIGATION IMPROVEMENTS
CURRENT PLAN

NAVIGATION IMPROVEMENTS
JONESPORT HARBOR, MAINE
DESIGN MEMORANDUM
BREAKWATER, CHANNEL, AND ANCHORAGES

A. PERTINENT DATA

1. Purpose. Design a project plan which will provide a breakwater, channel and protected anchorages to adequately and safely accommodate the present and prospective local fishing fleet.

2. Location. Jonesport is located on the north side of Moosabec Reach in Washington County, Maine, about 190 miles northeast of Portland, Maine, and about 40 miles southwest of the Canadian border at Eastport, Maine. The harbor extends about three miles east and west along the north shore of Moosabec Reach.

3. Physical Features. A combined rubble-mound and cellular steel sheet pile breakwater, 1200 feet in length; a 15-acre anchorage composed of nine acres, six feet deep and six acres, eight feet deep; and an entrance channel 100 feet wide and eight feet deep.

4. Principal Quantities.

Dredging Channel & Anchorages	57,000 c.y.
Breakwater Foundation Excavation (Unsuitable Soil)	24,700 c.y.
Cell Fill (Sand & Gravel)	55,400 c.y.
Cover Stone (Cells & Breakwater)	12,800 ton
Bedding Stone (Cells & Breakwater)	5,200 ton
Gravel Fill (Breakwater)	4,500 c.y.
Steel Sheet Piles	159,200 s.f.

5. Estimated Cost. (1 Oct. 1979 Price Level)

Channel and Anchorages	
Dredging	$ 419,000
Contingencies	51,000
Total Dredging Cost	$ 470,000
Breakwater	
Steel Sheet Pile Cells	$2,853,000
Cathodic Protection	395,000
Coating	195,000
Excavation	247,000
Cell Fill	554,000
Gravel Fill	45,000
Bedding Stone	87,000

Cover Stone	243,000
Contingencies	690,000
Total Breakwater Construction Cost	$5,310,000
Archaeological Salvage Cost	20,000
Engineering and Design	295,000
Supervision and Administration	425,000
Total Construction Cost	$6,520,000
Aids to Navigation	20,000
Total Estimated First Cost	$6,540,000

6. Cost Apportionment.

Federal (USCE & USCG)	$6,540,000
Non-Federal	0

7. Economic Analysis.

Annual Benefits	$ 685,000
Annual Charges	510,000
Benefit-Cost Ratio	1.4 (1.37) to 1.0

B. INTRODUCTION

1. General. This memorandum presents the Phase I and II post authorization reports. Approval to waive the Phase I requirement and to combine both phases of the report was granted from the Office of the Chief of Engineers by letter indorsement, dated 3 November 1977, subject to the condition that a concentrated effort would be made to resolve the dredge disposal problem prior to the commitment of extensive effort on design studies. Resolution of this problem is described in this memorandum. The needs, objectives and project formulation as discussed in the following Sections F & H reaffirm the continued need for the project plan as presented in the authorizing document. Design modifications have been made to reflect the results of further more detailed explorations, but the basic project scope remains the same.

2. Purpose. The purpose of this memorandum is to present an objective reassessment of the authorized project to either reaffirm the project design as authorized or to reformulate the project plan as required to meet changed conditions. Its purpose is also to provide engineering data and cost estimates of sufficient detail to serve as a basis for approval to proceed with plans and specifications and subsequent construction of the project.

3. Scope. This memorandum discusses all features of the project. It presents data on the project need, function, design, estimated costs and benefits, construction schedule, maintenance requirements and related local cooperation.

C. PROJECT AUTHORIZATION

4. Authorization. The Jonesport Harbor Navigation Improvement Project was authorized under provisions of Section 201, Flood Control Act of 1965 (P.L. 89-298) and approved by House Resolution dated 23 September 1976 and Senate Resolution dated 1 October 1976; The pre-authorization report is published as House Document No. 94-481, 94th Congress, 2nd Session.

5. Requirements of Local Cooperation. Construction of the authorized project for navigation improvement was recommended provided that, prior to construction, local interests furnish assurances satisfactory to the Secretary of the Army that they will:

a. Provide without cost to the United States all lands, easements, and rights-of-way required for construction and subsequent maintenance of the project and for aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and also necessary retaining dikes, bulkheads, and embankments therefor or the costs of such retaining works;

b. Hold and save the United States free from damages that may result from the construction and maintenance of the project;

c. Provide, maintain, and operate necessary mooring facilities and utilities including a public landing in Sawyer Cove with berthing depths alongside the landing commensurate with the depth provided in the entrance channel, an adequate access road, parking area, and suitable related facilities, open to all on equal terms, including transients;

d. Accomplish without cost to the United States such utility or other relocations or alterations as necessary for project purposes;

e. Reserve space within the harbor adequate for the accommodation of transient craft.

f. Regulate the use, growth, and free development of the harbor facilities with the understanding that said facilities will be open to all on equal terms, including transients; and

g. Establish regulations prohibiting discharge of pollutants into the waters of Jonesport Harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention control.

D. AUTHORIZED PLAN

6. Description. The authorized project provides for a steel sheet pile breakwater, 1,200 feet in length; a 15-acre anchorage composed of nine acres, six feet deep and six acres, eight feet deep; and an entrance channel 100 feet wide and eight feet deep.

E. PROJECT LOCATION AND TRIBUTARY AREA

7. Location and Description. The town of Jonesport is located on the north side of Moosabec Reach in Washington County, Maine, about 190 miles northeast of Portland Maine, and about 40 miles southwest of the Canadian border at Eastport, Maine. Jonesport Harbor is that part of Moosabec Reach adjacent to the Jonesport mainland extending from Kelley Point on the east to Hopkins Point on the west. Moosabec Reach extends from Chandler Bay westward to Western Bay between the mainland shore of Jonesport and a series of large islands, which include Great Wass, Beal and Norton Islands that define the south side of Moosabec Reach.

Jonesport Harbor extends along the shore about three miles east to west. Although much of the area immediately adjacent to the mainland is shallow, depths a short distance off the shore range from 20 to 40 feet, except for a bar at the eastern end of the Reach which has a dredged depth of 14 feet over a 300-foot width. The average depth in the six mile long Reach is 25 feet. Sawyer Cove forms a partly sheltered natural anchorage about one-quarter mile east of the center of town and three-quarter miles west of Kelley Point. Depths in Sawyer Cove range from about two to eight feet at mean low water.

Moosabec Reach is exposed to east and west winds, but is sheltered on the north by the mainland, and on the south by the large islands. Tidal currents flood to the eastward and ebb to the westward attaining velocities up to 1.7 miles per hour. The mean tide range is 11.5 feet, the spring tide range is 13.2 feet and extreme low tides fall 3.0 feet below mean low water. The east end of Moosabec Reach opens into the Gulf of Maine. Consequently, easterly and southeasterly storms cause the more severe wave conditions especially when running against a flooding tide. Wave heights approaching eight feet have been observed along the center of the Reach and five foot waves have been experienced adjacent to the Jonesport shore.

Ice sheets form in coves and between sheltered portions of the islands during the winter months. These sheets break up with successive changes in the tide. Chunks of ice move into the Reach on ebb tide. Winds from the southwest and southeast blow the ice toward the Jonesport side causing severe damage to boats moored along the shoreline. Northeasters cause the ice to move against the Beals Island shorefront forcing boats moored at Perio Point and the north side of Beals Island to seek temporary shelter in Beals Harbor and other nearby coves. The locality is shown on Plate No. 1.

8. Tributary Area. The area immediately tributary to Jonesport Harbor is the town of Jonesport, Washington County. The population of Jonesport in 1975 was 1504. It increased by 18 or 1.2 percent in the 15-year period 1960 - 1975. During the 10-year period 1960-1970, the population decreased by 150 or 11.2 percent and from 1970 to 1975 increased by 168 or 12.6 percent. Washington County has been declared a Title IV(1) area of persistent and substantial unemployment by the Economic Development Administration. Although the town derives some income from seasonal visitors, the principal means of livelihood is commercial fishing with its associated activities. Lobster, herring, scallops, shrimp, groundfish and under utilized species comprise the catch made by the local fleet. There are 5 fishing companies and 3 boat-building firms in Jonesport. Peat moss is harvested from local bogs for shipment throughout the country. The town's only link with land transportation is via State Highway Route 187. There is no railroad, airline or ferry service within the town. However, there is a railroad freight terminal located at Columbia Falls, sixteen miles northwest of Jonesport.

F. CURRENT NEEDS AND DEVELOPMENT OBJECTIVES

9. Needs. The prime need for navigation improvement in Jonesport Harbor is for a protected anchorage to adequately and safely accommodate the local fishing fleet. The principal difficulties attending navigation stem from the exposed position of the harbor to storm waves. With the exception of Sawyer Cove, the entire shoreline is exposed. Boats and lobster cars moored in the deep water of the Reach break loose and drift onto the rocky coast. Severe damage occurs to boats during the winter from ice packs drifting through Moosabec Reach on the flood and ebb tides. There have been several instances where ice floes have carried boats away, necessitating rescue by a U.S. Coast Guard icebreaker. This exposure has discouraged local fishermen from developing any adequate terminals from which to operate.

The State of Maine has indicated that Jonesport-Beals is one of fifteen high activity fish ports having priority fish pier needs. However, a public fish pier cannot be constructed until breakwater protection is provided.

10. <u>Development Objectives</u>. The objective is to provide navigational improvements, consisting of a breakwater and a dredged anchorage in Sawyer Cove, that will provide a protected harbor of sufficient size to accommodate the present and prospective fishing fleet. The present size of the fishing fleet exclusive of row boats and outboards is 50 lobster boats plus nine carriers, trawlers and draggers. No new lobster boats are expected to be added to the fleet following the harbor improvement. However, it is expected that four trawlers and eight draggers in the 60-foot category and two 110-foot draggers will be added to the fleet during the estimated 50-year project life. Consequently, future needed anchorage capacity is for 50 lobster boats, 21 carriers, trawlers and draggers in the 60-foot category and two 110-foot draggers.

Using an average length of 30 feet for the lobster boats, a 13.5-foot spring tide range, a six-foot deep anchorage requirement, and the free overlapping circle method of mooring, results in an anchorage capacity of nine acres for the lobster boats. The 23 deeper draft fishing vessels moored in an eight-foot anchorage depth would require an anchorage capacity of six acres. Therefore, the total anchorage area required in Sawyer Cove would be 15 acres. To reach the anchorage area from deep water in Moosabec Reach, it would be necessary to dredge a channel through a bar at the entrance to Sawyer Cove.

G. INVESTIGATIONS

11. <u>Previous Investigations</u>. Physical investigations carried out in support of the survey report were made in 1968, 1970, and 1971. These investigations consisted of detailed soundings, one core boring, 30 hand probes and four machine probes.

In addition to the above investigations, environmental sampling, consisting of five pressed piston tubes, were made in 1972 within the areas to be dredged.

12. <u>Post-Authorization Investigations</u>. Investigations undertaken in support of this Design Memorandum include:

a. Hydrographic and topographic surveys made in January and February 1978 in the breakwater, anchorages and entrance channel areas to measure the depth of the harbor bottom below mean low water and the ground elevation above mean low water at Henry Point.

b. Hydrographic and scuba diver surveys made in May 1978 in the disposal area to measure the depths at the disposal site and along its access routes to confirm the bottom substrate type, and to evaluate the existing benthic communities, habitat and currents.

c. Three core borings and 11 machine probes made in February and March 1978 in the foundation area of the authorized breakwater alignment to determine the soil characteristics and distribution and the depth of bedrock.

d. Seismic surveys made in July 1979 in the breakwater foundation area and to the north and south of the authorized alignment to determine the depth of bedrock.

e. One core boring and eight machine probes made in October 1979 in the breakwater foundation area along the revised alignment to determine the soil characteristics and distribution and to confirm the bedrock depths indicated by the seismic surveys.

f. Compilation and analysis of tidal, major storms, wind and wave data for establishing criteria for design of the breakwater.

13. Public Meetings. Three public meetings were held in Jonesport, Maine, as follows:

a. First Meeting, 4 April 1968. Preauthorization stage. To determine type of navigation improvements desired by local interests and the need for the improvements. Sixty-six people attended the meeting, including representatives of Federal, State and local Governments. Local interests requested two sites be considered for construction of a breakwater-pier to provide safe mooring area for commercial fisherman operating from Jonesport.

b. Second Meeting, 24 May 1972. Preauthorization Stage. To present the plan of improvements as a result of study efforts prior to finalizing the survey report. Sixty-one people attended the meeting, including representatives of Federal, State and local Governments. All present approved the presented plan of improvement.

c. Third Meeting, 30 October 1979. Post authorization stage. To present results of design memorandum studies including the detailed plan of improvement, attendant costs and benefits, environmental impacts, items of local cooperation and schedule for completion of the project. Thirty-five people attended, including representatives of Federal, State and local Governments. Those expressing opinions favored the selected project plan. Some were concerned about support facilities, such as land access to Sawyer Cove and parking facilities. Attendees were informed that these support facilities were the responsibility of the town of Jonesport and had to be provided by the town. Two written statements were submitted. One by the Maine Department of Transportation which favored the project and indicated their full support. The other statement received ~~by~~ from the owner of a lobster company, northwest of the proposed breakwater alignment, was not in opposition to the project but was concerned that the breakwater would deflect freshwater flows, entering from a brook at the head of Sawyer Cove, through his lobster floats. The freshwater, if of sufficient magnitude, would kill the lobsters. This condition will be examined, including field monitoring, if required, during continued preconstruction planning.

H. PROJECT FORMULATION AND EVALUATION

14. Preauthorization Studies and Plan. The two sites within Sawyer Cove suggested by local interests at the initial public meeting on 4 April 1968 were considered for the 15-acre anchorage. One site was as far inside the cove as physically possible to obtain maximum protection from the surrounding land mass. Provision of an anchorage at this site would have required a breakwater at the entrance to Sawyer Cove 1,000 feet long to provide full protection. The second site for the anchorage was in the relatively deep water behind the entrance bar and the first ledge outcrop. Protection of this site would have required a 1,200-foot long breakwater located on the entrance bar. A comparison of the costs for providing the anchorage at these two sites was made and the seaward location was found to be much less costly. The inner anchorage would have involved a high cost for removal of ledge and an extensive quantity of ordinary materials from shoal areas. The high costs for the inner anchorage were greater than the cost of the additional 200 feet of breakwater necessitated for the entrance site. Location of the anchorage closer to the entrance would also leave room for future expansion of the anchorage should the need arise.

A third breakwater site investigated to provide protection from storms and ice floes moving through Moosabec Reach was located just east of the Beals Island Bridge. However, to provide even a minimum of sheltered anchorage, the breakwater would have to extend southerly from the shore well out into deep water and then westerly for a total distance of 1500 feet to inclose an area of about seven acres. The estimated cost of construction for a 1500-foot rubble-mound breakwater at this site would amount to more than $10,000,000. This cost would greatly exceed the benefits and not all of the boats needing protection could be accommodated. Other types of breakwater designs were considered with similar results. It was concluded that breakwaters at any site in Jonesport, other than in Sawyer Cove, would indicate similar benefit-cost results.

A tentative plan of improvement, consisting of a conventional rubble-mound breakwater at the entrance to Sawyer Cove and a 15-acre anchorage area in the cove, was presented to local officials in 1970. This plan was found acceptable. However, probings and borings taken in 1970 and 1971 along the breakwater alignment revealed unsuitable foundation conditions for the conventional design of a rubble-mound breakwater. A design for a wide-berm, rubble-mound breakwater was then considered which could have been constructed for these conditions. The cost of this construction resulted in an unfavorable benefit-cost ratio of 0.53 to 1.0.

Two alternate designs using steel construction for the breakwater were considered: (a) double row walls of steel sheet piling, and (b) circular cells. Thirty (30)-foot diameter circular cells, connected by steel diaphragm arcs and filled with sand and gravel for stabilization against wave action and capped with cover stone to protect the structure from overtopping, proved most feasible and economical.

The formulated or improvement plan, as a result of the preauthorization studies, consisted of an entrance channel 100 feet wide and eight feet deep leading from deep water in Moosabec Reach into Sawyer Cove; two anchorages within the cove of nine acres, six feet deep, and six acres, eight feet deep, protected by a cellular steel sheet pile breakwater extending from Henry Point southwest for a distance of 650 feet, then west across the entrance to Sawyer Cove, an additional distance of 550 feet. This was the plan authorized for construction.

15. Postauthorization Studies and Plan. A review of the authorized plan during the early phase of the postauthorization studies confirmed that the need for the breakwater and the size and depth of anchorages still existed, but design modifications were necessary due to added field data. Additional explorations made in 1978 and seismic surveys made in 1979 revealed that unusual deep pockets of very soft materials existed in the foundation area of the authorized breakwater alignment. The bedrock surface varied in depth from approximately elevation minus 21 feet to minus 65 feet below mean low water as shown by the exploration and seismic survey results on Plate Nos. 3, 5, and 6. Construction of the sheet pile breakwater along the authorized alignment was no longer feasible nor economical.

A revised alignment avoiding the deep pockets of soft materials was evaluated. A wide-berm rock breakwater was also further examined as a possible alternate. The results indicated that the realigned steel sheet pile structure remained the most economic solution. A stable structure was realized by driving the sheet piling to bedrock and by increasing the diameter of the individual cells from the authorized diameter of 30 feet to 50 feet. One additional core boring and eight machine probes were made along the revised alignment to confirm the depth of the bedrock surface revealed by the seismic surveys. One probe revealed the possibility of a deep pocket of soft material at the west end of the alignment. Additional probes will be made prior to the issue of plans and specifications for bids to determine more accurately the length of sheet piles and to compile a more accurate detailed quantity estimate.

I. COORDINATION

16. General. All Federal, State, and local agencies having an interest in Jonesport Harbor were consulted during the preauthorization study and postauthorization phase concerning the effects of the plan of improvement on their activities. The views of these interest groups were given full consideration with regard to all aspects of the project. Most of the coordination with the various Federal, State and local interests concerned environmental considerations, scheduling of construction and location of an acceptable disposal area for the dredged material.

A Section 404 Water Quality Certificate was requested by letter on 12 September 1979 from the Maine Department of Environmental Protection (DEP) and a consistency determination was filed 24 September 1979 with the Maine State Planning Office. A Water Quality Certificate, No. 08-6316-29250, was issued for the project on 16 November 1979 by the State of Maine, Department of Environmental Protection. Response to the consistency determination was received from the Maine State Planning Office 9 November 1979. They have concluded that the proposed navigation improvement will be consistent with Maine's Coastal Program provided that construction and disposal data are reviewed and approved by the Department of ~~Maine~~ Marine Resources (DMR) and DEP. In a subsequent discussion with DMR representatives, it has been agreed that dredging and disposal may be accomplished October through May and that monitoring of disposal would not be required.

An archaeological site exists on Henry Point. The site has been determined eligible for inclusion in the National Register by the Heritage Conservation and Recreational Service of the U.S. Department of the Interior. Archaeological salvage of the site, by the Maine Historic Preservation Commission will be accomplished during the summer of the first construction year.

Comments of the various Federal and State agencies and approval of the disposal site are contained in Appendix C.

J. ENVIRONMENTAL ANALYSIS

17 General. An Environmental Impact Statement and Section 404 Evaluation have been completed. Construction of the project would provide an immediate and lasting beneficial impact on the town of Jonesport by restoring and expanding the commercial fishing industry with a much needed navigation improvement. The community would benefit from the improvement as it impacts on the major source of income, the fishing industry. The breakwater would afford protection to the fishing fleet. It would reduce damage to boats, moorings, and

lobster cars by centering activities of the fishing fleet in Sawyer Cove. No major adverse effects are anticipated. The breakwater would occupy a small area of bottom habitat and would create minor change in circulation within the cove.

The dredging of the channel, anchorages and removal of unsuitable material from the breakwater foundation could have a minor adverse impact to the fish life and fish habitat, but the impact, if any, will be temporary. This stems from the increased level of turbidity which will take place during the dredging and excavation processes.

The disposal site along the west shore of Sheep Island has been selected in cooperation with town officials, fishing interests and Federal and State agencies. Disposal of dredged material may have some adverse environmental impacts on marine life, but these impacts are also expected to be of a temporary and minor nature.

K. PROJECT PLAN

18. General. The project plan considered most feasible and economical provides for an entrance channel 100 feet wide and eight feet deep leading from deep water in Moosabec Reach into Sawyer Cove; two anchorages within the cove of nine acres, six feet deep and six acres, eight feet deep; and a combined 1,200-foot rubble-mound and cellular steel sheet pile breakwater. The plan involves the removal of about 24,700 cubic yards of soft unsuitable organic silt from the breakwater foundation and about 57,000 cubic yards from the channel and anchorages. In view of the odiferous and organic nature of the material to be removed, and the lack of suitable land areas to accommodate this type of material, dredging of the channel and anchorages will be by bucket dredge and removal of material from within the cells by clamshell, with disposal in an approved offshore dumping area. The project plan, typical sections and the location of the disposal site are shown on Plate Nos. 1, 2, and 3.

19. Breakwater. The breakwater extends from Henry Point southwest for a distance of about 350 feet, then west across the entrance to Sawyer Cove, an additional distance of approximately 850 feet. A rubble-mound section is provided as a transition between rock at Henry Point and the cellular steel sheet pile portion of the breakwater in deeper water. Wave diffraction and refraction studies indicate that the location of the breakwater would provide maximum effectiveness in overall protection of the cove against storm waves entering Moosabec Reach from the east or southeast. Waves would be reduced to a height of less than two feet in the anchorages under storm conditions. Waves of this magnitude are tolerable for the type and size of craft that would use the anchorages.

Design height of the breakwater was fixed at 18.0 feet above mlw, based on a design tide of 13.2 feet and a design wave of 5.0 feet. This height is expected to prevent damage to the craft behind the breakwater, due to overtopping by wave runup. The rubble-mound section would have a crest width of 15 feet and side slopes of 1.0 vertical and 1.5 horizontal and will consist of a gravel fill core protected by layers of bedding and cover stone. Each cell of the breakwater would be 49.3 feet in diameter filled with sand or sand and gravel to elevation +13.5 feet mlw and capped with 1.5 feet of bedding stone and 3.0 feet of cover stone.

All sheeting will be driven to bedrock. Prior to placement of the sand or sand and gravel cell fill material, soft unsuitable foundation materials will be removed either to firm soil/bedrock or to elevation -25.0 feet mlw, whichever is the highest, to insure stability of each individual cell and of all the cells acting as a unit. Sheeting will be of the marine type, coated with epoxy and electrical cathodic protection. It is expected that the steel sheet piling would serve for the proposed 50-year project life.

This breakwater provides the minimum structural features necessary to provide adequate protection for the existing and prospective fishing fleets, while maximizing net benefits.

20. Channel and Anchorages. The size and depths of the channel and anchorages were designed to provide for the current and prospective fishing fleets. The present local fishing fleet, exclusive of row boats and outboards, consists of 50 lobster boats and nine carriers, trawlers and draggers. These boats vary in size from 25 to 65 feet. Prospective additions to the fleets are estimated to include four trawlers and eight draggers in the 60-foot category and two-110 foot draggers. No new lobster boats are expected to be added. The 15-acre anchorage area is expected to accommodate all craft, tied fore and aft on moorings.

21. Disposal Area. As part of the requirements of local cooperation, local interests were required to furnish suitable onshore disposal sites for the dredged materials. However, due to the absence of suitable onshore areas it will be necessary to dispose of the material offshore by bottom dump scows. Jonesport officials suggested that a shallow water area about 1.5 miles southeast of Jonesport Harbor, along the west shore of Sheep Island would be a suitable site. According to local interests the area is not used by the fishing industry and has no economic value as such.

The Environmental Protection Agency and the Maine Department of Marine Resources have concurred with this proposed site for disposal. Although the original intent was to establish a clam flat at the disposal site, the reduced quantity and type of material negated that concept. However, the material will be dumped in such a manner as to create a worm flat. In order to develop a worm bed, it will be necessary to dump the dredged material in a mound that would extend to a height of at least three feet above mean low water. Disposal of the material will be accomplished on higher stages of the tidal cycle to facilitate clearance of the scow doors when open. With the high tidal range in the area it is anticipated that a final top elevation sufficient to create a mud flat totalling about three acres in area could be developed.

Hydrographic and scuba diver surveys of the disposal area were made in May 1978 to measure the depths at the disposal site and along its access routes, to determine the optimum location and size of the mound, to confirm the bottom substrate type, and to evaluate the existing benthic communities, habitat and currents. The disposal site is ringed by ledge outcrops which could act effectively in reducing normal wave and tidal current action and to prevent erosion and subsequent spreading of the dredged material. According to the U.S. Fish and Wildlife Service "Classification of Wetlands and Deep-water Habitats of the United States, " the area is classified as a marine subtidal habitat consisting of a composite of bedrock outcrops, silty sand and rock and gravel patches. Small clumps of eel grass, brown and green algae are the dominant plants. Invertebrates observed included the horse mussel, urchin and northern sea cuccumber. The distribution of these animals is patchy and restricted to the occasional isolated small rocks. Welks, periwinkle, bivalene, shrimp and hermit crabs were found on the silty sand substrate. On the basis of the prevailing bottom sediments and biotic communities, it has been concluded that the average currents encountered will not cause excessive erosion to the deposited materials.

L. DEPARTURES FROM THE PROJECT DOCUMENT PLAN

22. Departures. The following changes have been made to the authorized project plan:

a. A 350-foot rubble-mound section has been added to provide a transition between the rock abutment at Henry Point and the cellular steel sheet pile portion of the breakwater in deeper water. This section was a steel sheet pile structure in the authorizing document.

b. The diameter of the individual cells has been increased from 30 to nearly 50 feet to insure stability due to overturning and sliding.

c. The quantity of unsuitable material to be removed from the breakwater foundation has been decreased from 90,000 to 24,700 cubic yards.

M. GEOLOGY AND SOILS

23. Geology. The geologic history of the Maine Coast is one of glacial scour and deposition. Some materials were directly deposited by the glacial ice; others were washed into the ocean or deposited in melt water streams that flowed off the ice. The resulting profile at the project structures is a highly irregular igneous bedrock surface whose deep irregularities have been filled with stiff silts and clays that in turn have been overlain with recent deposits of soft organic silts and clays.

24. Explorations and Tests. Five core borings, twenty-three machine probes and seismic surveys were made along the breakwater alignment and its immediate vicinity to determine the overburden soil characteristics and distribution and the bedrock profile. All soil samples were visually classified using the Unified Soil Classification System. Grain size, Atterberg Limits, specific gravity, natural water content and organic content tests were performed on selected samples to confirm visual classifications and to provide precise data wherever required. The seismic reflection survey was conducted to provide a 5.0-foot contour map of the inferred bedrock surface. The locations of all explorations are shown on Plate Nos. 3 and 5.

25. Presentation of Data. Logs of borings and probing results are shown on Plate No. 5. Results of seismic surveys defining the elevation of the bedrock surface are shown on Plate No. 3. A summary of laboratory soil tests results is shown on Plate No. 7. A generalized soil profile and selected test data on the foundation soils are shown on Plate No. 6.

26. Soil Conditions. The elevation of the ground surface in the foundation area of the breakwater varies from eight to nine feet below mean low water in the cove area, rising to 18 feet above mean low water at Henry Point at the easterly end of the breakwater. Exposed bedrock, capped by a thin deposit of sand, gravel, and scattered boulders shows above low tide along the eastern shore. The bedrock surface in the foundation area of the breakwater alignment, as indicated by the explorations and seismic surveys, varies in general between elevation -21 feet and -28 feet mlw except for the deep pockets shown on the soil profile (Plate No. 6) which extend to elevations -44 feet and -65 feet mlw. The deep pockets are filled with inorganic medium to stiff clay (CL) with organics and the entire area overlain with a deposit of very soft organic silt (OL) and organic clay (OL & OH) approximately 15 feet thick. A thin (2'-3') layer of gravelly sand occurs sporadically at the interface between bedrock and the overlying silts and clays.

27. Foundation Treatment. Foundation treatment in the cellular cofferdam type breakwater shall consist of removal of the upper zone

of soft organic material to elevation -25 feet mlw or to bedrock, whichever is higher. Removal of this material will be done after the sheet piles for the cells have been driven to bedrock.

In the foundation area of the rubble-mound breakwater, the organic silt and the scattered surface boulders will be removed prior to its construction.

28. Availability of Construction Materials. Large deposits of sand and gravel materials are located in undeveloped regions of the Montegail Pond Area known locally as the Blueberry Barrens, approximately 20 miles northwest of Jonesport. Smaller deposits may be available in the Car Hill and Gilman Hill area approximately 15 miles north of Jonesport.

Large armor size rock from developed quarry sources is available at Deer Isle, Maine approximately 70 miles from the project site. Small riprap size rock is available from undeveloped sources in the immediate vicinity of the project.

O. OTHER PLANS INVESTIGATED

29. Alternate Design Investigations. One alternate design, consisting of a rubble-mound type breakwater for the full length of the proposed location and at the authorized alignment was investigated. However, due to the soft foundation conditions, extensive berms about 50 feet in width on either side of the main breakwater section coupled with the removal of a portion of the upper zone of organic silt would be required to obtain overall stability. The benefit-cost ratio was computed to be less than 1.0. Therefore, construction of a rubble-mound breakwater was considered neither practical nor economical.

Two other type breakwaters, consisting of a double row steel pile wall and a cellular steel sheet pile design were then considered. Only the cellular steel sheet pile design appeared worthy of detailed study. This design forms the basis of the recommended plan of improvement for breakwater protection.

P. REQUIRED AIDS TO NAVIGATION

30. General. The United States Coast Guard has been consulted in regard to establishing aids to navigation for the improvements under consideration. They have reported that the proposed improvement would require a single pole light at the outer end of the breakwater. The cost of installation is estimated at $20,000 with an annual maintenance cost estimated at $400.

Q. COST ESTIMATES

31. First Costs. Unit prices used in estimating project construction costs are based on 1 October 1979 price levels. Quantity estimates are based on hydrographic and topographic surveys made in 1978 and explorations and seismic surveys made in 1968, 1971, 1978, and 1979. The material from the channel and anchorages will be removed by bucket dredge and the unsuitable breakwater foundation material within the cells will be removed by clamshell bucket. The material will be placed in scows and hauled to the disposal site which is about 1-1/2 miles from the project site. It is estimated that about 57,000 cubic yards of material will have to be removed from the channel and anchorages and about 24,700 cubic yards from within the breakwater cells. Dredging quantities are based on in-place measurements and provide for removal to project depths below mean low water plus an allowance of one-foot overdepth. Side slopes for the channel and anchorages were estimated to be one vertical to three horizontal.

Construction costs include an allowance of 12% contingencies for dredging of the channel and anchorages and 15% contingencies for construction of the breakwater. Costs of engineering and design and of supervision and administration are based on experience, knowledge and evaluation of the site and project, and comparison with similar projects in the general area. The total first cost of the project is estimated at $6,540,000. A summary of current costs for the project features is given in Table 1 on the following page.

TABLE

SUMMARY OF COSTS
(1 October 1979 Price Level)

Acct.	Project Features	Estimated Cost
09.	Channel and Anchorages	
	Dredging, 57,000 c.y. @ $7.35/c.y.	$ 419,000
	Contingencies (12%)	51,000
	Total Dredging Cost	$ 470,000
10.	Breakwater	
	Steel Sheet Pile Cells, 159,200 s.f. @ $17.92/s.f.	$2,853,000
	Cathodic Protection, 1 Job L.S	395,000
	Coating (Coal Tar), 169,000 s.f. @ $1.16/s.f.	196,000
	Excavation, 24,700 c.y. @ $10.00/c.y.	247,000
	Cell Fill, 55,400 c.y. @ $10.00/c.y.	554,000
	Gravel fill, 4,500 c.y. @ $10.00/c.y.	45,000
	Bedding Stone, 5,200 tons @ $16.80/ton	87,000
	Cover Stone, 12,800 tons @ $19.00/ton	243,000
	Construction Cost	$4,620,000
	Contingencies (15%)	690,000
	Total Breakwater Construction Cost	$5,310,000
18.	Archaeological Salvage Cost--1 Job L.S.	20,000
30.	Engineering and Design	295,000
31.	Supervision and Administration	425,000
	Total Construction Cost	$6,520,000
	Aids to Navigation	20,000
	Total Estimated First Costs	$6,540,000

32. Annual Charges. Average annual charges, summarized below in Table 2, are based on an anticipated project life of 50 years and an interest rate of 7-1/8 percent. Maintenance costs are based on an average annual shoaling rate of 1,500 cubic yards in the anchorages and channel. Average annual maintenance charges for breakwater repairs are based on the need for replacing the anti-corrosive protective devices as shown by experience with other steel pile structures exposed to similar conditions.

TABLE 2

ANNUAL CHARGES

Federal and Non-Federal Investment	
Construction First Cost	
U.S. Corps of Engineers	$6,520,000
U.S. Coast Guard	20,000
Local Interests	0
Total Federal and Non-Federal Investment	$6,540,000
Annual Charges	
Interest and Amortization (.073607 X 6,540,000)	$ 481,000
Maintenance	
Dredging, 1,500 c.y.@ $9.00	13,600
Breakwater	15,000
Aids to Navigation	400
Total Annual Charges	$ 510,000

33. Comparison of Cost Estimates. A comparison of project cost estimates since the survey report are summarized in Table 3 on the following page.

TABLE 3
COMPARISON OF COST ESTIMATES

	Authorizing Document Estimate (June 1972)	Latest Approved Estimate (1 Oct 1979)	Current Estimate (1 Oct 1979)
Dredging	$ 262,000	$ 460,000	$ 470,000
Breakwater	2,914,000	5,300,000	5,310,000
Archaeological Salvage	0	0	20,000
Engineering & Design	147,000	275,000	295,000
Supervision & Administration	225,000	425,000	425,000
Aids to Navigation (USCG)	12,000	18,000	20,000
	$3,560,000	$6,478,000 1/	$6,540,000 2/

1/ The cost increase in construction features was based on price escalation from 1972 to 1979. The E&D and S&A cost increases were due to reanalysis of requirements, overhead and Federal pay increases.

2/ Increase in costs from latest approved estimate is based on relocating breakwater slightly north of authorized plan alignment, and additional exploration and seismic survey information providing better definition of quantities. Archaeological salvage of Henry Point increased costs by $20,000.

R. ESTIMATE OF BENEFITS

34. Introduction. The benefit analysis is based on a 50-year project life at 7-1/8 % interest rate. The benefits are considered general in nature and are expected to accrue primarily from increased fishing time gained by elimination of delays in landing the catch at Jonesport, providing new markets for the fishing resource, reduction in storm damages to fishing vessels, and reduction in the cost of mooring maintenance caused by rough weather and ice floes. The improvement would also serve as a harbor of refuge for the locally based Coast Guard vessels under adverse weather conditions. In addition, certain employment benefits will result. A summation of estimated benefits is shown in Table 5 on page 26 of this report.

35. Developments Since Authorization Report. An analysis of fisheries resources was made in a conservation and development report dated 3 March 1972 by the U.S. Department of the Interior through its Fish and Wildlife Service in cooperation with the Maine Department of

Marine Resources (DMR), and the National Marine Fisheries Service (Department of Commerce). The original report discussed the fishery benefits which could be expected to accrue from the project.

Perhaps the greatest single change since the authorization report was the passage of the Extended Fisheries Jurisdiction Act. This Act has limited the fishing activities of foreign vessels within 200 miles of the United States coastline and has established guidelines for effective management of fisheries resources. With improved conservation practices, Federal and State fisheries officials anticipate fish stocks will rebuild and domestic fishermen will experience very significant increases in catches. These increases are expected to take place along the entire coast of Maine, most certainly in the Jonesport area.

Jonesport Harbor as a fishing community is strategically located near extremely productive fishing grounds. Given adequate protection from storms and restoration of shore facilities, State and local interests believe that the fishing industry in Jonesport will prosper.

The location of Jonesport in relation to the fishing grounds; the exposed conditions existing in Moosabec Reach and along the Jonesport shore, making boats, piers and other structures vulnerable to storms; ice floes that move through the Reach during the winter months and limited wharf facilities, due to a lack of protection, are all valid reasons to provide a completely safe mooring area.

Since completion of the authorization report in 1972, a public landing has been constructed in Sawyer Cove as recommended in the report. The landing was constructed with Federal/State funding. As a result of this construction, most of the tidal delay inconvenience experienced by lobster fishermen having to drag their skiffs across mudflats at low tide to get to their boats has been eliminated. However, tidal delays are still experienced in the use of the landing due to shoals in the Cove and exposure to storm conditions due to a lack of a breakwater.

There have been three major storms and many lesser ones since 1972. The storm of February 2, 1976 caused extensive damages to wharves, seawalls, fish plants, lobster pounds, boats and gear in the area.

A January 9, 1978 storm caused less damage to Jonesport property but the fishing industry did incur losses.About one month later the February 6-7, 1978 storm completely destroyed some of the facilities damaged by the January storm. There was widespread damage to shore facilities particularly the public landing in Sawyer Cove. Although the 1972 report listed 13 wharves in Jonesport, as a result of these storms there are presently only three remaining. These wharves have had to be rebuilt or extensively repaired.

According to the tax records of Jonesport, there were some 250 boats of all types assessed in 1977. Several new boats have been added to the fleet in 1978. The estimated value of the fishing fleet was $485,500 in 1977. The composition of the fleet is largely lobster boats of various sizes and skiffs or other small craft used by shellfish harvesters. Up to eleven boats have been engaged in the new fishery of harvesting blue mussels.

While the fleet recently included draggers, seiners and sardine carriers, some larger vessels have had to leave Jonesport because of a lack of protected wharf space where they could tie up and unload. There are at least six trawlers operating from Rockland, Maine, some 85 air miles west of Jonesport, fishing the prime finfish grounds off Jonesport. These boats would save at least ten hours running time if they could unload their catch at Jonesport. On an average these boats make the trip to Rockland about one and one-half times a week. Consequently, some 90 hours of costly non-productive running time would be saved each week if the six boats were able to operate from a protected harbor at Jonesport.

This example illustrates that the harbor is strategically located near what have been for years extremely productive fishing grounds. The Jonesport area is also the home of many of the State's most experienced and capable fishermen. This combination of natural resources and talent support the contention, that given protection from storms and ensuing restoration of shore facilities, the fishing industry at Jonesport will prosper as it never has before.

Improved shrimp landings were listed as a significant benefit in the 1972 report. Since then the New England Shrimp Fishery has entered one of its historic cyclic declines, and no shrimp landings are likely in the next few years at Jonesport. However, there is reason to believe that this resource will recover, as it has before when conditions are more favorable. Should this happen following improvement of the harbor, larger boats will again be based at Jonesport, providing for expanded shore facilities to take full advantage of this valuable resource. Based on this assumption, there appears to be no reason for eliminating the benefits assigned to the shrimp industry. On the contrary, projections as to the future indicate that the annual net benefits are likely to be much higher for this species.

36. Annual Benefits. The following paragraphs describe the nature and extent of annual benefits estimated for Jonesport Harbor. The methodology used to quantify the benefits is presented in Appendix B.

a. Lobstering. Lobstering remains the main fishing activity in Jonesport. On a statewide basis some scientists have expressed doubt about the possibility of increasing the lobster catch significantly through increased fishing. However, the Maine DMR does not agree with this outlook nor do the most recent statistics support it. The 1978 lobster catch for Maine totaled 19,130,500 pounds valued at $33,878,400. This represents an increase in overall landings of 643,400 pounds (+3.5%) over the 1977 level.

Landing data are not reported for specific ports by either the State of Maine or Federal agencies. Data is available, however, on a county basis. Table 4 indicates the lobster landings and value for Washington County. Actual landings for the State are also noted. Although yearly gains and losses have occurred in Washington County during the 14 year period 1965-1978, simple regression analysis shows a declining trend averaging 50,000 pounds per year.

TABLE 4

LOBSTER CATCH

	Washington County		State of Maine
	(lbs)	(Value)	(lbs)
1965	2,545,100	1,915,600	18,861,800
1966	2,858,600	2,108,600	19,915,800
1967	2,180,500	1,776,600	16,489,200
1968	2,925,000	2,110,900	20,501,700
1969	2,589,300	2,028,400	19,834,800
1970	2,248,400	2,146,300	18,172,300
1971	2,170,400	2,236,800	17,558,400
1972	1,906,200	2,248,900	16,256,500
1973	2,193,200	3,039,300	17,044,200
1974	2,092,200	2,979,700	16,457,700
1975	1,909,600	3,191,900	17,017,400
1976	2,488,600	3,873,600	19,001,100
1977	2,020,400	3,579,800	18,487,100
1978	1,935,700	3,486,500	19,130,500

Because of the exposed location of Jonesport Harbor, lobstering time is lost between March 1 and December 31 due to rough harbor conditions. An average of 30 fishing days is lost each year when the harbor is too rough for lobstermen to row out to their boats to transfer gear and bait. It is estimated that 10 of the 30 days will be so rough that lobstering would be impossible even if the proposed project were constructed. The navigation improvement would eliminate delays caused by rough weather, tidal range, and ice conditions resulting in an additional 20 days of fishing time. With this added time, it was estimated that the fishermen could catch 150,000 pounds of lobster. The Main DMR has accepted, in the interest of conservatism, the assumption that the 150,000 lbs would not actually be an increase but would offset a declining trend as evidenced by the

Washington County statistics. Consequently, on a without and with project comparison the net result is the same regardless of which assumption i.e., an increase or an offset to a decrease, serves as the framework.

As the lobstermen would be extending their productive time in existing vessels the only additional costs would be operating costs such as fuel, labor, extra traps, line and bait. These added costs, required to obtain the 150,000 pounds of lobster are estimated to be 20 percent of the gross value of the catch. At the latest ex-vessel price for Washington County of $2.00 per pound the net benefit to the lobster industry would total $240,000.

b. <u>Shrimp</u>. As noted earlier, the New England shrimp fishery is in one of its historic cyclic declines. Last recorded landings in Washington County were in 1975. The Main DMR fishery experts project a return of shrimp within the next 25 years. During the previous favorable phase of the cycle the Jonesport fleet caught only a small fraction of the shrimp available. If more and larger vessels were available the catch would have been significantly higher.

It is assumed that the next favorable cycle will occur in the late 1990's or some 15 years following completion of the project. Its duration is estimated at 15 years with no recurrence during the remainder of the projects 50-year life.

With the return of the shrimp, four new 60 foot trawlers would be based at Jonesport Harbor each capable of landing 160,000 lbs. annually. The expense of the investment in the new trawlers and their operation would total some 50 percent of the ex-vessel value of the projected catch. The latest ex-vessel price for shrimp is $.70 per pound. Converting the estimated benefits to be derived during the future shrimp cycle to present worth and amortizing the value over the project life results in an estimated average annual benefit of $53,100. Details of this computation are presented in Appendix B.

c. <u>Groundfish</u>. Maine DMR and industry experts estimate that eight draggers in the 60-foot class and two in the 110-foot class would be added to the local fleet with an immediate impact on the groundfish production at Jonesport, especially on cod and flounder. Although considered conservative the estimated increased catch of 900,000 pounds of cod and 100,000 pounds of flounder as projected in the 1972 report has been retained. Utilizing the latest available ex-vessel prices of $.17 and $.35 per pound for cod and flounder respectively and allowing a 50 percent reduction for operating expenses for new vessels the net annual benefit totals $94,000.

The Maine DMR also stated that additional landings of haddock, hake and pollock would be realized. An estimated increase of 1,135,000 pounds would result comprised of 625,000 pounds of pollock, 385,000 pounds of hake and 125,000 pounds of haddock. At ex-vessel prices of \$.16, \$.13 and \$.40 for pollock, hake and haddock, respectively, and with a 50% reduction for operating costs, the total annual benefit is \$100,000. Accordingly, the total annual benefit for finfish landings (five species combined) amounts to \$194,000.

d. Scallops. Local officials note that as the larger boats are added to the fleet increased production from off-shore scallop grounds will result. Since dragger fishermen traditionally shift from species to species during different seasons, it is likely that the four new draggers or trawlers to be added to the shrimp fleet and the existing fleet would fish for scallops as well as shrimp. It is estimated that the scallop harvest will be increased each year through use of this fleet reaching a total annual harvest in project life 50 of 195,000 pounds. Because this added scallop catch will be accomplished partly by existing vessels and partly by new boats the operating costs will vary from 20 to 50 percent. Using an average operating cost of 40 percent, an ex-vessel price of \$3.00 per pound and converting the annual increase to an average annual equivalent value the benefit for increased scallop catch is \$93,900.

e. Herring. Demand for this fish source currently exceeds supply especially large herring used for smokers and bloaters. The supply is limited by the lack of harbor improvements. With completion of the project, and its associated protection, the existing fleet is expected to land an additional 300,000 pounds of herring annually. At the prevailing ex-vessel price of \$.09 per pound and allowing for a 20 percent reduction for operating expenses the net annual benefit is \$21,600.

f. Dogfish. The potential increase for dogfish remains as included in the 1972 authorization report. Fishermen report the amount of dogfish in the area appears to have increased and markets are reported as better than ever. Due to the relatively low margin of profit, dogfish is a high volume industry and larger vessels, such as those that would be attracted to the harbor following improvement, are needed to develop the fishery. It is estimated that 1.5 million pounds of dogfish will be landed annually immediately following improvement at an ex-vessel price of \$.07 per pound. Allowing a 50% reduction for investment and operating expenses the average annual dogfish benefit totals \$52,500.

g. Mooring Damage. Under existing conditions nearly all of the locally based fishing fleet must moor in the open and deep waters of Moosabec Reach. The boats are subjected to waves, from easterly storms, ranging up to eight feet in height in the center of Moosabec Reach and up to five feet along the Jonesport shore. On occasion these boats break their moorings and drift onto the rocky shoreline. As previously mentioned, there have been three major destructive storms in the last three years.

By mooring the boats and lobster cars in a sheltered anchorage, considerable savings could be realized in the cost of mooring tackle required to withstand buffeting and dragging from storm waves and from a total loss of the moorings by ice floes passing through the open reach. The cost of mooring a boat in the open reach amounts to approximately $500 per year for the smaller boats and $1,000 per year for the larger ones. Local interests have stated that a sheltered mooring area would reduce the annual costs for maintaining moorings by $210 for each of the lobster boats and $400 each for the nine existing, large fin fishing vessels. This amounts to a total annual savings of $14,100.

h. Boat Damage. The fishermen who fish during the winter months experience damage from ice floes that vary in thickness from a few inches to more than a foot. Tide currents flow east during flood and west on ebb tide with a velocity reaching 0.4 knots causing ice to be trapped in Moosabec Reach for long periods. A Coast Guard vessel, based at Jonesport, periodically has to retrieve boats that are torn from their moorings. It is assumed that some 85 percent of the damage to these vessels could be eliminated. A lobster boat experiences about $330 in damages annually, reflecting prevailing prices, and the larger boats $500 in annual damage. Based on an estimated 24 lobster boats and the nine larger boats pursuing winter fishing the total average reduction in ice damage amounts to $10,600.

i. Employment. The Washington County labor market area which includes Jonesport has been classified as a Title IV(1) redevelopment area since 1966. Project construction activity would provide emloyment opportunities for the underemployed and unemployed resulting in an average annual benefit of $17,400. The derivation of the employment benefit is presented in Appendix B.

37. Summary. A summary of the average annual benefits follows:

TABLE 5
SUMMARY OF ANNUAL BENEFITS

Description	Amount
Increased lobster catch	$240,000
Increased shrimp catch	53,100
Increased groundfish catch	194,000
Increased scallop catch	93,900
Increased herring catch	21,600
Increased dogfish catch	52,500
Reduction in mooring damage	14,100
Reduction in boat damage	10,600
Employment	17,400
TOTAL ANNUAL BENEFITS	$697,200

S. BENEFIT TO COST RATIO

38. Benefit-Cost Ratio. Comparison of the evaluated benefits of $697,200 and the annual charges of $510,000 results in a benefit-cost ratio of 1.4 (1.37) to 1.

T. LOCAL COOPERATION

39. Local Assurances. Local interests will be required to provide the items of local cooperation as recommended in the authorizing document and included in Paragraph 5 of this report. A request for formal assurances from the town of Jonesport will be made after approval of this Design Memorandum.

40. Views of Local Interests. Meetings have been held with local officials during post authorization planning. The present general plan, project features and project costs were outlined and discussed at the Public Meeting held on 30 October 1979 in Jonesport, Maine.

Officials of the town of Jonesport and the State of Maine have expressed their strong support for early construction of the project. Local officials have noted their intent to provide the necessary assurances at the appropriate time. Letters of comment and concurrence are included in Appendix C.

U. SCHEDULE FOR DESIGN AND CONSTRUCTION

41. General. The project will be constructed under two contracts. An initial contract for dredging of the channel and anchorages will be awarded in March of the first construction year. Salvaging of the archaeological site at Henry Point will be accomplished by the Maine

Historic Preservation Commission during the summer. It is expected that the dredging and salvage work will each be completed in about two months. A second contract to construct the breakwater will be awarded in early fall of the first construction year. The breakwater contract is expected to be completed in 1-1/2 years.

V. OPERATION AND MAINTENANCE

42. General. Maintenance of the project is a Federal function and will consist of periodic dredging to restore project depths within the limits of the project and also to replace the steel anti-corrosive devices as shown by experience with other steel pile structures exposed to similar conditions. The estimated additional annual maintenance dredging quantities are based on a shoaling rate of 1500 cubic yards per year at an annual cost of $13,600. Replacement annual cost of the anti-corrosive devices are estimated to be $15,000.

W. STATEMENT OF FINDINGS

43. General. As Division Engineer of the New England Division, I have reviewed and evaluated, in light of the overall public interest, all pertinent data concerning the proposed construction of the authorized Federal navigation improvement project at Jonesport Harbor, Maine. Elements considered in this review included engineering feasibility, environmental impacts, stated views of other interested agencies and the concerned public, and socio-economic factors relative to the various practical alternatives in providing a safe mooring area for commercial fishermen operating in Jonesport Harbor.

The aspects and possible consequences of alternatives have been studied in detail and have already been discussed in length in the formulation of the plan of improvement. In the analysis which I have made, I find no alternative plan or combination of alternative plans which would fulfill the requirements of the authorized project to the same extent as the proposed plan. In summary, there are substantial benefits to be derived from providing local fishermen with a protected mooring area in Sawyer Cove which is the only area in Jonesport Harbor where such an improvement could be economically provided.

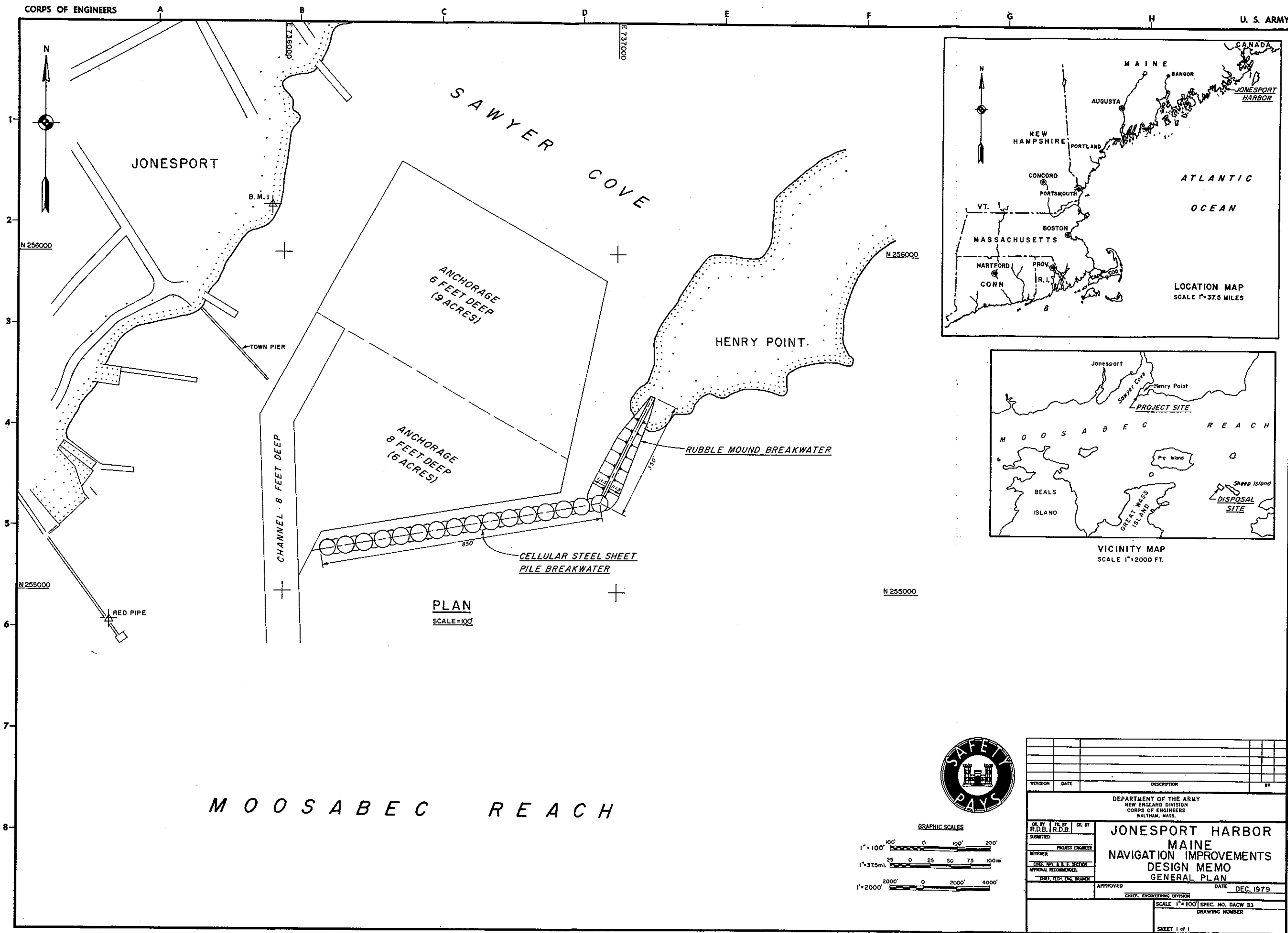
It is noted that the improvement will cause a minor disruption of the environment during dredging and building of the breakwater through temporary turbidity at the construction site. Also, the breakwater when completed would change the aesthetic appearance of the area immediately adjacent to the entrance to the cove. Due to the dependence of the local economy on the fishing industry, it is considered that these adverse environmental effects would be more than offset by improvement in the economic growth of the area. Local interests are firmly convinced that an increase in employment with a resulting increase in property values would not be realized without the proposed navigation improvements.

I find that the proposed action as developed in this design memorandum is based on thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objective; that wherever adverse effects are found to be involved they cannot be avoided by following reasonable alternative courses of action which would achieve the Congressionally specified purposes; that where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations. The recommended action is consonant with national policy, statutes and administrative directives and on balance, the total public interest should best be served by the implementation of the recommended proposal.

Max B. Scheider
MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

X. RECOMMENDATIONS

44. Recommendations. The proposed plan will serve adequately the present and prospective needs of the harbor and is economically justified. It is recommended that this Design Memorandum be approved as a basis for preparation of contract plans and specifications for the Jonesport Harbor Navigation Improvement project.


CORPS OF ENGINEERS
U. S. ARMY
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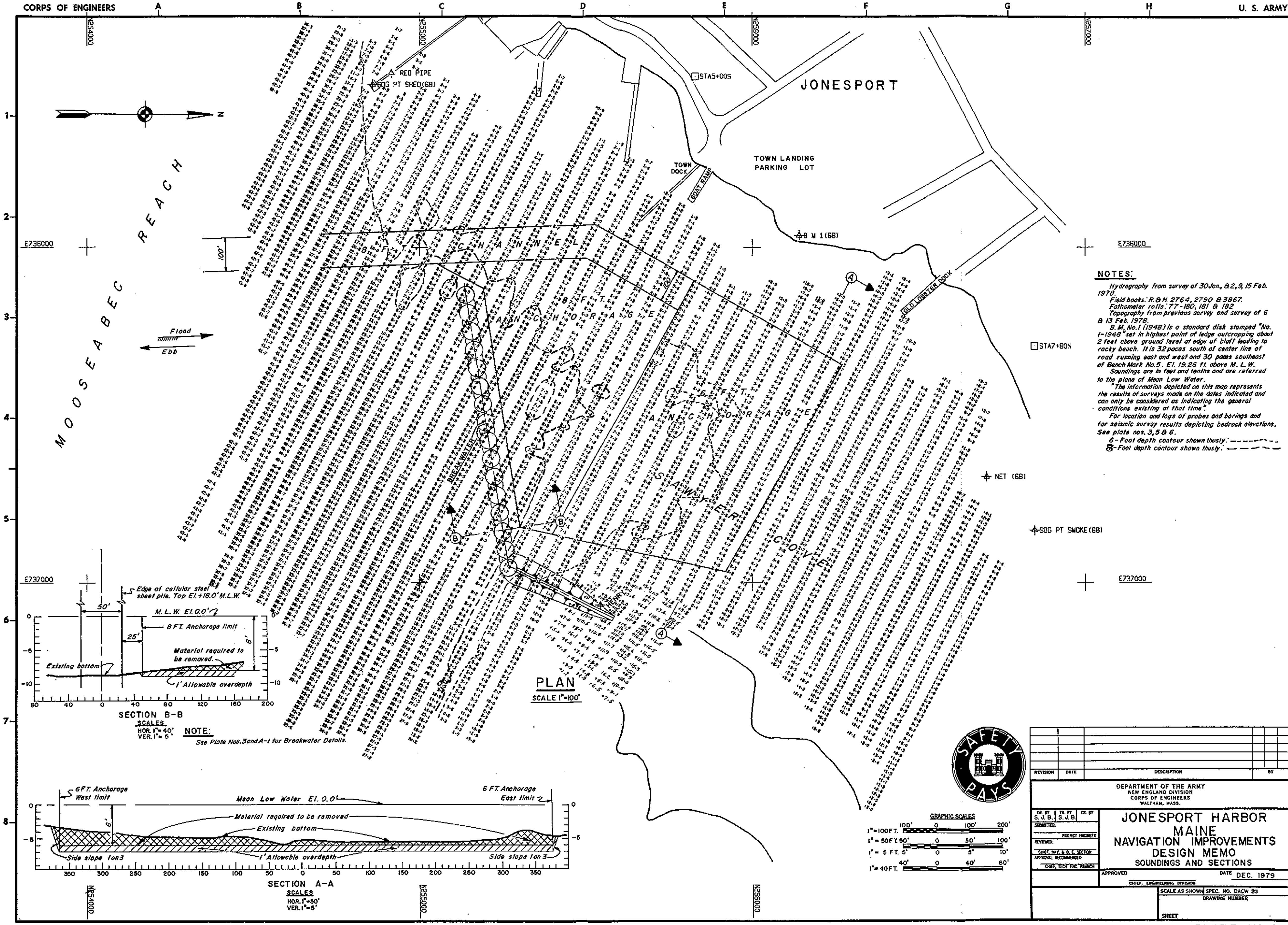
JONESPORT
B.M. 1
TOWN PIER
RED PIPE
SAWYER COVE
ANCHORAGE 6 FEET DEEP (9 ACRES)
ANCHORAGE 8 FEET DEEP (6 ACRES)
CHANNEL 8 FEET DEEP
HENRY POINT
RUBBLE MOUND BREAKWATER
350'
850'
CELLULAR STEEL SHEET PILE BREAKWATER
PLAN
SCALE = 100'
MOOSABEC REACH
MAINE
BANGOR
AUGUSTA
CANADA
JONESPORT HARBOR
NEW HAMPSHIRE
PORTLAND
CONCORD
PORTSMOUTH
VT.
BOSTON
MASSACHUSETTS
HARTFORD
PROV.
R.I.
CONN
ATLANTIC OCEAN
LOCATION MAP
SCALE 1" = 37.5 MILES
Jonesport
Sawyer Cove
Henry Point
PROJECT SITE
MOOSABEC REACH
Pig Island
Sheep Island
DISPOSAL SITE
BEALS ISLAND
GREAT WASS ISLAND
VICINITY MAP
SCALE 1" = 2000 FT.
SAFETY PAYS
GRAPHIC SCALES
1" = 100'
1" = 37.5 mi.
1" = 2000'
REVISION
DATE
DESCRIPTION
BY
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
R.D.B.
R.D.B.
JONESPORT HARBOR
MAINE
NAVIGATION IMPROVEMENTS
DESIGN MEMO
GENERAL PLAN
APPROVED
DATE DEC. 1979
SCALE 1" = 100'
SPEC. NO. DACW 33
DRAWING NUMBER
SHEET 1 of 1

PLATE NO. 1

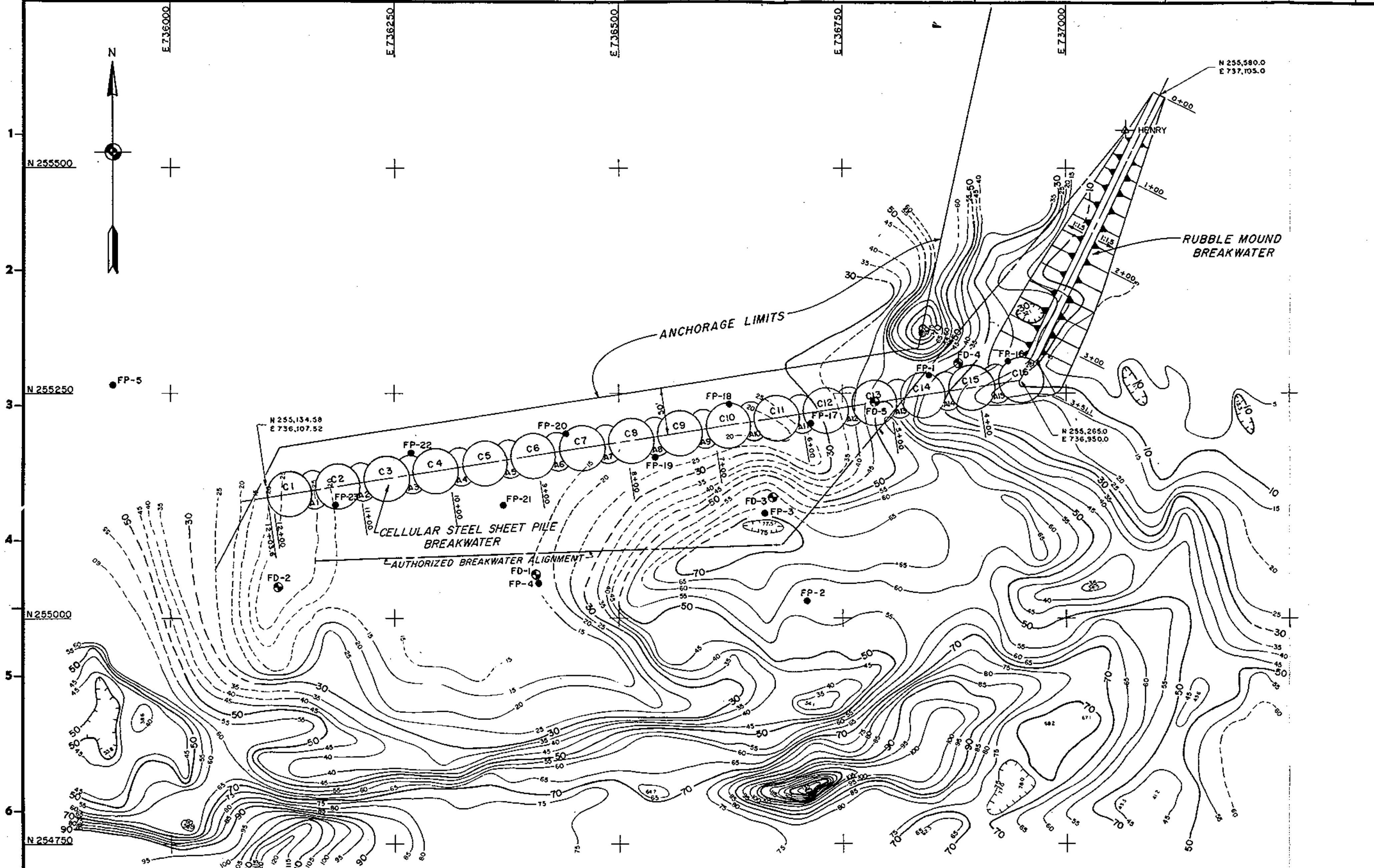


CORPS OF ENGINEERS
U. S. ARMY
JONESPORT
TOWN LANDING PARKING LOT
TOWN DOCK
BOAT RAMP
RED PIPE
SOG PT SHED (68)
STA5+005
B M 1 (68)
OLD LOBSTER DOCK
STA7+80N
NET (68)
SOG PT SMOKE (68)
MOOSEABEC REACH
Flood
Ebb
18 FT. CHANNEL
8 FT. ANCHORAGE
6 FT. ANCHORAGE
SAWYER COVE
BREAKWATER
E736000
E737000
N254000
N255000
N256000
N257000
100'
PLAN
SCALE 1"=100'
NOTES:
Hydrography from survey of 30 Jan., & 2, 9, 15 Feb. 1978.
Field books: R.& H. 2764, 2790 & 3867.
Fathometer rolls: 77-180, 181 & 182
Topography from previous survey and survey of 6 & 13 Feb. 1978.
B. M. No. 1 (1948) is a standard disk stamped "No. 1-1948" set in highest point of ledge outcropping about 2 feet above ground level at edge of bluff leading to rocky beach. It is 32 paces south of center line of road running east and west and 30 paces southeast of Bench Mark No. 5. El. 19.26 ft. above M. L. W.
Soundings are in feet and tenths and are referred to the plane of Mean Low Water.
"The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time".
For location and logs of probes and borings and for seismic survey results depicting bedrock elevations, See plate nos. 3, 5 & 6.
6-Foot depth contour shown thusly:
8-Foot depth contour shown thusly:
Edge of cellular steel sheet pile. Top El. +18.0' M.L.W.
50'
M. L. W. El. 0.0'
8 FT. Anchorage limit
25'
8'
Material required to be removed.
Existing bottom
1' Allowable overdepth
SECTION B-B
SCALES
HOR. 1"= 40'
VER. 1"= 5'
NOTE:
See Plate Nos. 3 and A-1 for Breakwater Details.
6 FT. Anchorage West limit
6 FT. Anchorage East limit
Mean Low Water El. 0.0'
Material required to be removed
Existing bottom
1' Allowable overdepth
Side slope 1 on 3
Side slope 1 on 3
SECTION A-A
SCALES
HOR. 1"=50'
VER. 1"=5'
GRAPHIC SCALES
1"=100 FT.
1"= 50 FT.
1"= 5 FT.
1"= 40 FT.
SAFETY PAYS
REVISION
DATE
DESCRIPTION
BY
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
DR. BY S. J. B.
TR. BY S. J. B.
CK. BY
SUBMITTED:
PROJECT ENGINEER
REVIEWED:
CHIEF, NAV. & B. E. SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
JONESPORT HARBOR
MAINE
NAVIGATION IMPROVEMENTS
DESIGN MEMO
SOUNDINGS AND SECTIONS
APPROVED
CHIEF, ENGINEERING DIVISION
DATE DEC. 1979
SCALE AS SHOWN
SPEC. NO. DACW 33
DRAWING NUMBER
SHEET

PLATE NO. 2

CORPS OF ENGINEERS

U. S. ARMY

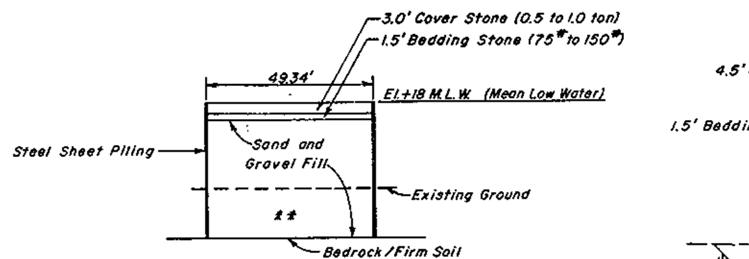


SCALE 1"=50'

NOTES:

1. Contours define bedrock elevations below Mean Low Water, as determined by seismic surveys.
2. Dashed contours inferred from a limited number of data points and observable trends in the seismic data.
3. Bedrock elevations calculated from water depths plus sediment thickness.
4. Water depths obtained from calibrated echo sounder.
5. Sediment thickness computed based on sound speed of 5150 ft/sec estimated as representive of sediment types reported in Corps of Engineers Borings.
6. For boring and probe results see Plate No's 5 & 6.

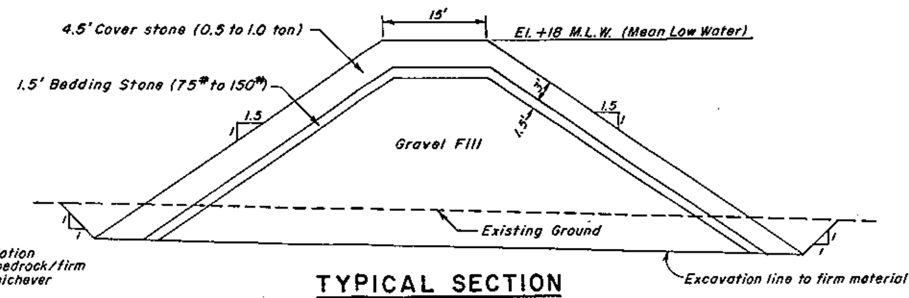
● FP-1 Foundation Machine Probe.
● FD-1 Foundation Drive Sample Boring.



NOTE
** Soft unsuitable foundation material to be removed to bedrock/firm soil or to elevation -25, whichever is higher.

TYPICAL SECTION
CELLULAR STEEL SHEET PILES

SCALE 1"=20'



TYPICAL SECTION
RUBBLE-MOUND

SCALE: 1"=10'

GRAPHIC SCALES

1"=10'
1"=20'
1"=50'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY R.D.B. | TR. BY R.D.B. | CK. BY

SUBMITTED: PROJECT ENGINEER

REVIEWED: CHIEF, NAV. & R. E. SECTION

APPROVAL RECOMMENDED: CHIEF, TECH. ENG. BRANCH

JONESPORT HARBOR
MAINE
NAVIGATION IMPROVEMENTS
DESIGN MEMO
BREAKWATER, BEDROCK CONTOURS, EXPLORATIONS & SECTIONS

APPROVED: CHIEF, ENGINEERING DIVISION

DATE DEC. 1979

SCALE AS SHOWN | SPEC. NO. DACW 33

DRAWING NUMBER

SHEET

PLATE NO. 3

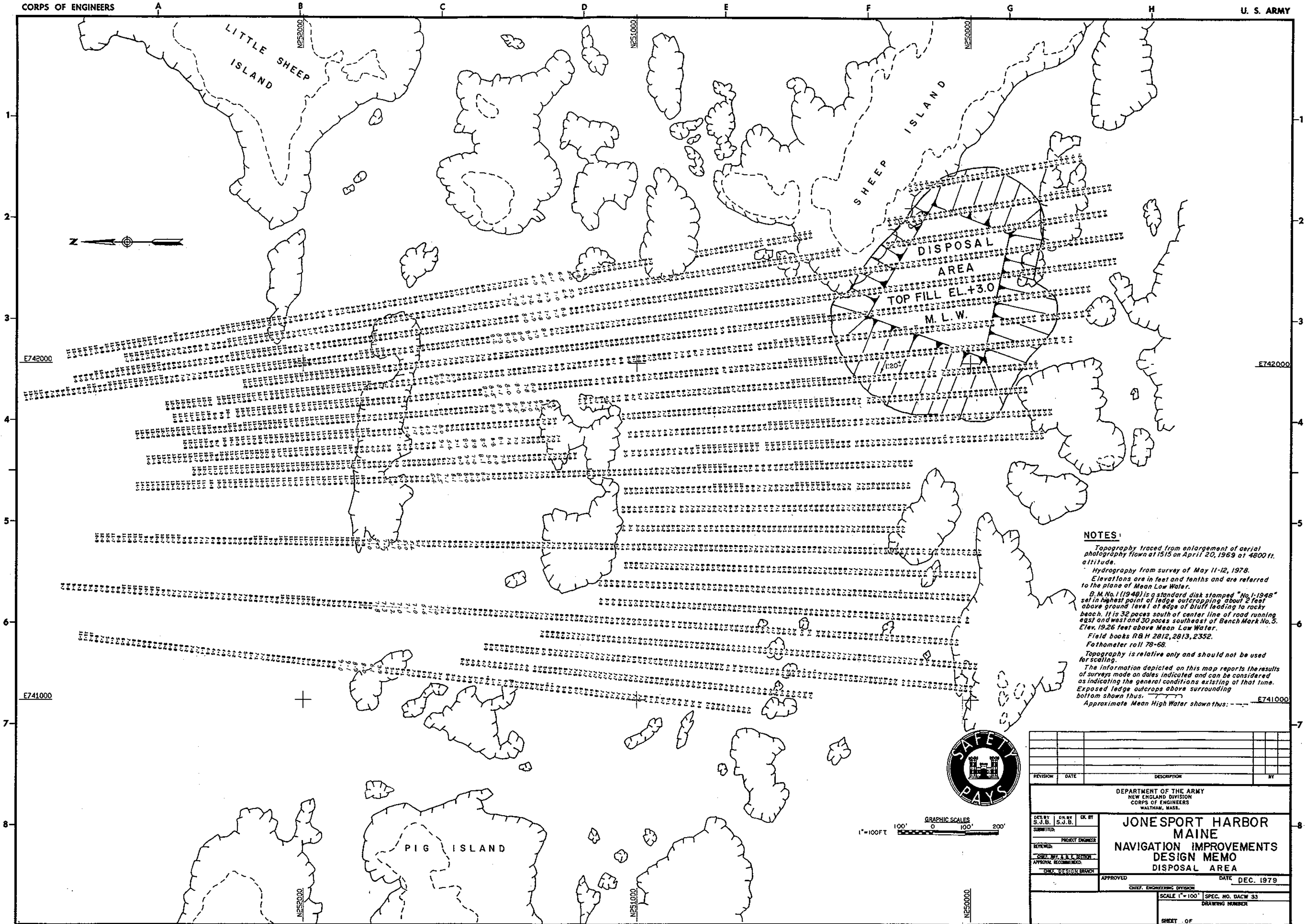
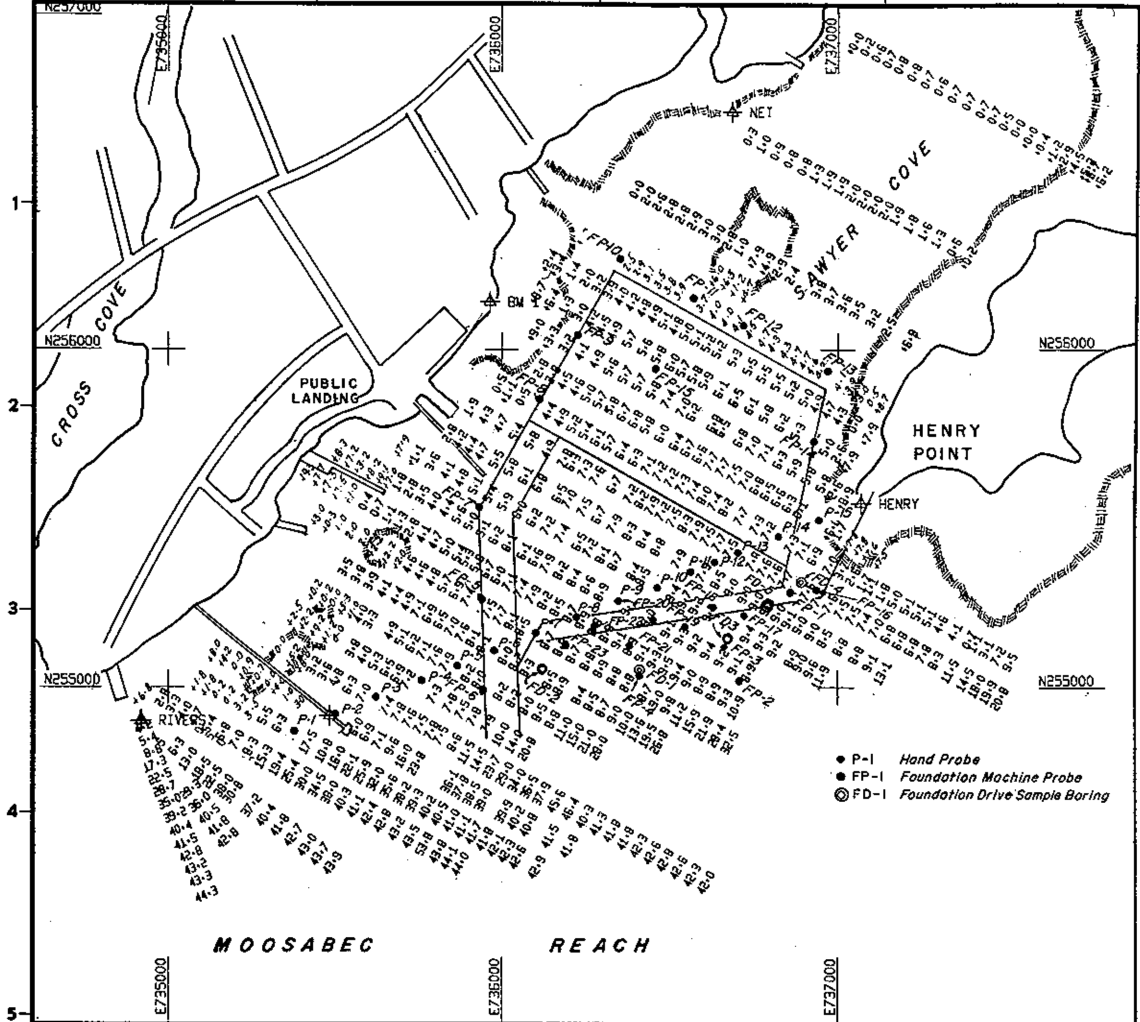
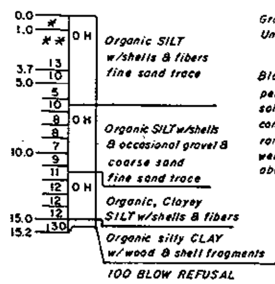

CORPS OF ENGINEERS
U. S. ARMY
LITTLE SHEEP ISLAND
SHEEP ISLAND
PIG ISLAND
DISPOSAL AREA TOP FILL EL.+3.0 M.L.W.
1:20
N252000
N251000
N250000
E742000
E741000
GRAPHIC SCALES
1"=100 FT.
100' 0 100' 200'
NOTES:
Topography traced from enlargement of aerial photography flown at 1515 on April 20, 1969 at 4800 ft. altitude.
Hydrography from survey of May 11-12, 1978.
Elevations are in feet and tenths and are referred to the plane of Mean Low Water.
B.M. No. 1 (1948) is a standard disk stamped "No. 1-1948" set in highest point of ledge outcropping about 2 feet above ground level at edge of bluff leading to rocky beach. It is 32 paces south of center line of road running east and west and 30 paces southeast of Bench Mark No. 5. Elev. 19.26 feet above Mean Low Water.
Field books R&H 2812, 2813, 2352.
Fathometer roll 78-68.
Topography is relative only and should not be used for scaling.
The information depicted on this map reports the results of surveys made on dates indicated and can be considered as indicating the general conditions existing at that time.
Exposed ledge outcrops above surrounding bottom shown thus:
Approximate Mean High Water shown thus:
SAFETY PAYS
REVISION
DATE
DESCRIPTION
BY
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
DES. BY S.J.B.
DR. BY S.J.B.
CK. BY
SUBMITTED:
PROJECT ENGINEER
REVIEWED:
CHIEF, NAV. & B. E. SECTION
APPROVAL RECOMMENDED:
CHIEF, DESIGN BRANCH
JONESPORT HARBOR
MAINE
NAVIGATION IMPROVEMENTS
DESIGN MEMO
DISPOSAL AREA
APPROVED
CHIEF, ENGINEERING DIVISION
DATE DEC. 1979
SCALE 1"=100'
SPEC. NO. DACW 33
DRAWING NUMBER
SHEET OF

PLATE NO. 4

CORPS OF ENGINEERS — U. S. ARMY



PLAN
SCALE 1" = 200'



LEGEND FOR GRAPHIC LOG

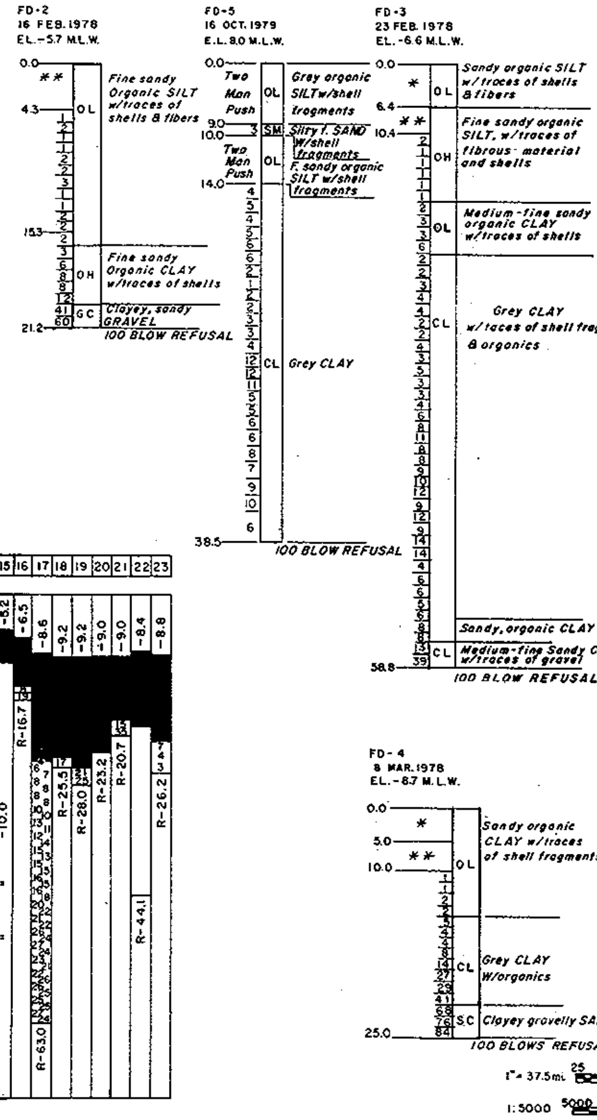
Foundation test boring.
Date exploration completed.
Elevation of ground surface at time of exploration.

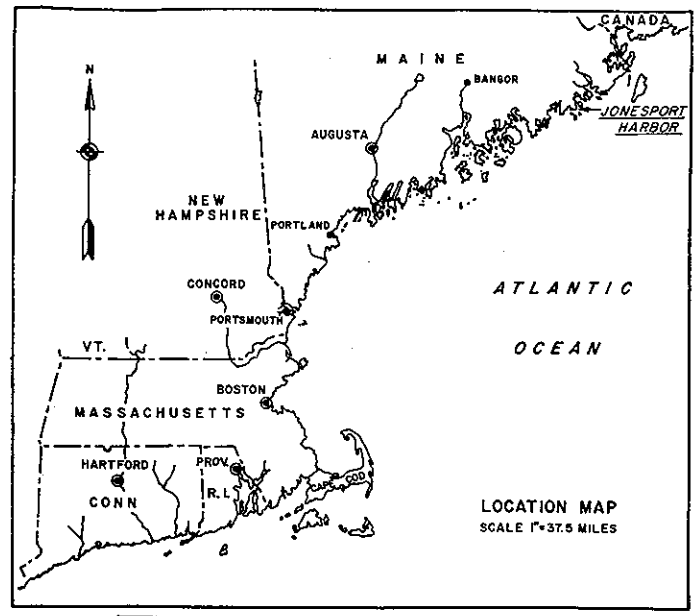
Group letter symbol according to Unified Soil Classification.

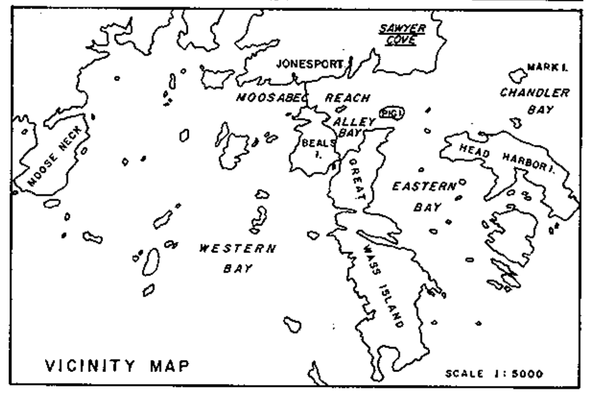
Blow counts per foot are for penetration of 1 1/2 inch I.D. solid sample spoon driven continuously for depth range of 5.0 feet by a drop weight of 140# falling about 30 inches.

* Penetration of 1 1/2" inch I.D. x 5.0 ft. solid sample spoon by weight of "E" rods.

** Penetration by weight of "E" rods and 140# hammer.







GENERAL NOTES:

Soundings are in feet and tenths and are referred to the plane of Mean Low Water.
Hydrography from survey of Jan. 24, 25, 30 & Feb. 2, 9, 6, 13 & 14, 1978.
Topography from previous survey.

B.M. #1 (1948) is a standard disk, stamped "No.1 1948" set vertically in highest point of ledge outcropping. About 2 feet above ground level at edge of bluff leading to rocky beach. It is 32 paces south of centerline of road running east and west and 30 paces southeast of Bench Mark No. 5. Elev. 19.26 feet above M.L.W.

Coordinates are on the Mercator Grid System for the State of Maine East Zone.

Field books: R.& H. 2764, 2790 & 3867.

Fathometer rolls: 77-180, 77-181 & 77-182.

"The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time."

LIST OF PROBINGS (P)

NUMBER (P-)	DEPTH OF WATER (Elevation below M.L.W.)	DEPTH OF PROBE (Elevation below M.L.W.)	PENETRATION	REMARKS
1	2.7	7.7	5.0	Soft mud
2	7.2	12.2	5.0	" "
3	6.4	11.7	5.3	" "
4	7.3	12.3	5.0	" "
5	8.2	13.3	5.1	Mud to hard pan
6	8.2	13.2	5.0	Soft mud
7	9.4	14.4	5.0	" "
8	9.2	14.5	5.3	" "
9	8.5	14.5	6.0	" "
10	9.2	14.4	5.2	" "
11	9.5	14.5	5.0	" "
12	9.5	14.8	5.3	" "
13	9.8	14.8	5.0	" "
14	8.6	14.6	6.0	" "
15	6.0	7.2	1.2	Refusal

PROBINGS taken with a 3/4" pipe forced down by two men until friction and density of material would allow no further penetration on those probes that grade was not obtained. Refusal does not indicate rock or ledge.
PROBES shown thus: ● P-2

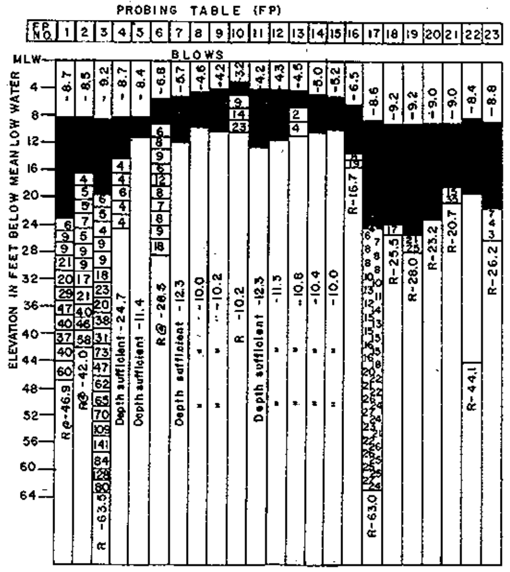
PROBING NOTES →

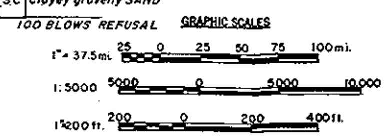
1. Figures in columns indicate number of blows required to advance steel rod a distance of 1-foot. Size, weight and length of drop of hammer are as shown in table below.

PROBING	ROD SIZE	WEIGHT HAMMER	HEIGHT DROP
FP-1-FP-4	1-3/16"	140#	30"
FP-5-FP-15	1 3/4"	350#	18"
FP-16-FP-23	1-3/4"	300#	18"

2. Shaded portion of column indicates advance of rod by two men push.
3. "R" indicates a refusal at the elevation shown to 100 blows with no penetration.

PROBING TABLE (FP)





REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DR. BY | TR. BY | CK. BY
SUBMITTED: PROJECT ENGINEER
REVIEWED: CHIEF, NAV. & B. C. SECTION
APPROVAL RECOMMENDED: CHIEF, TECH. ENG. BRANCH

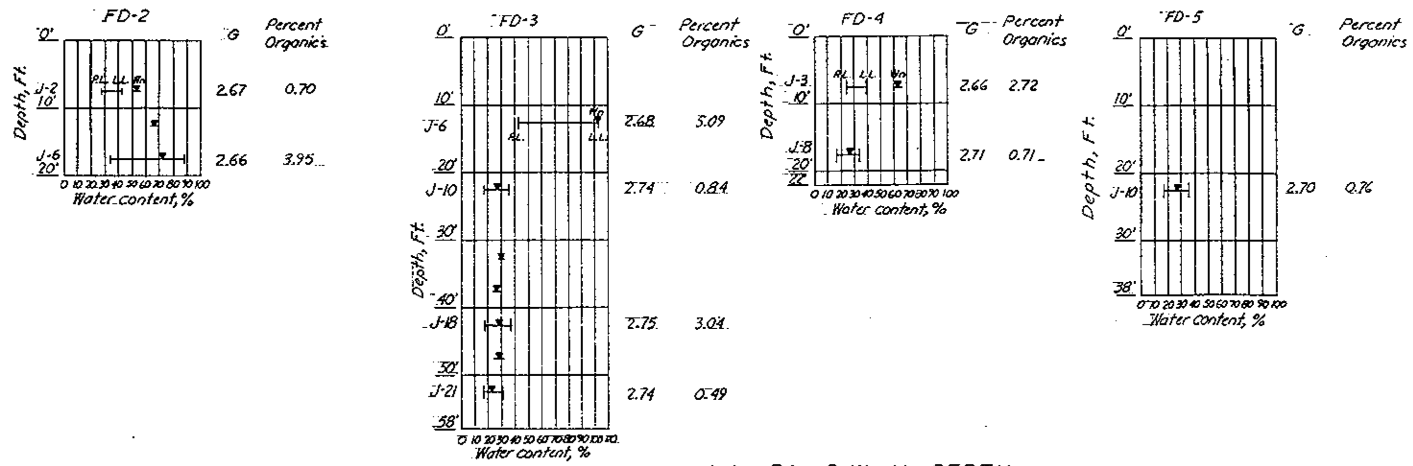
JONESPORT HARBOR MAINE
NAVIGATION IMPROVEMENTS DESIGN MEMO
BORINGS AND PROBINGS

APPROVED: CHIEF, ENGINEERING DIVISION
DATE DEC 1979

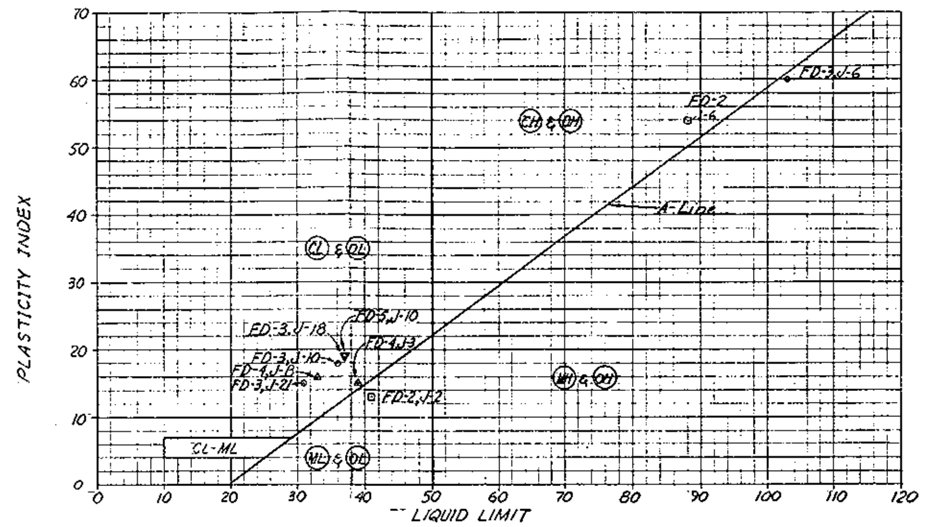
SCALE AS SHOWN | SPEC. NO. DACW 33
DRAWING NUMBER
SHEET 1 of

PLATE NO. 5

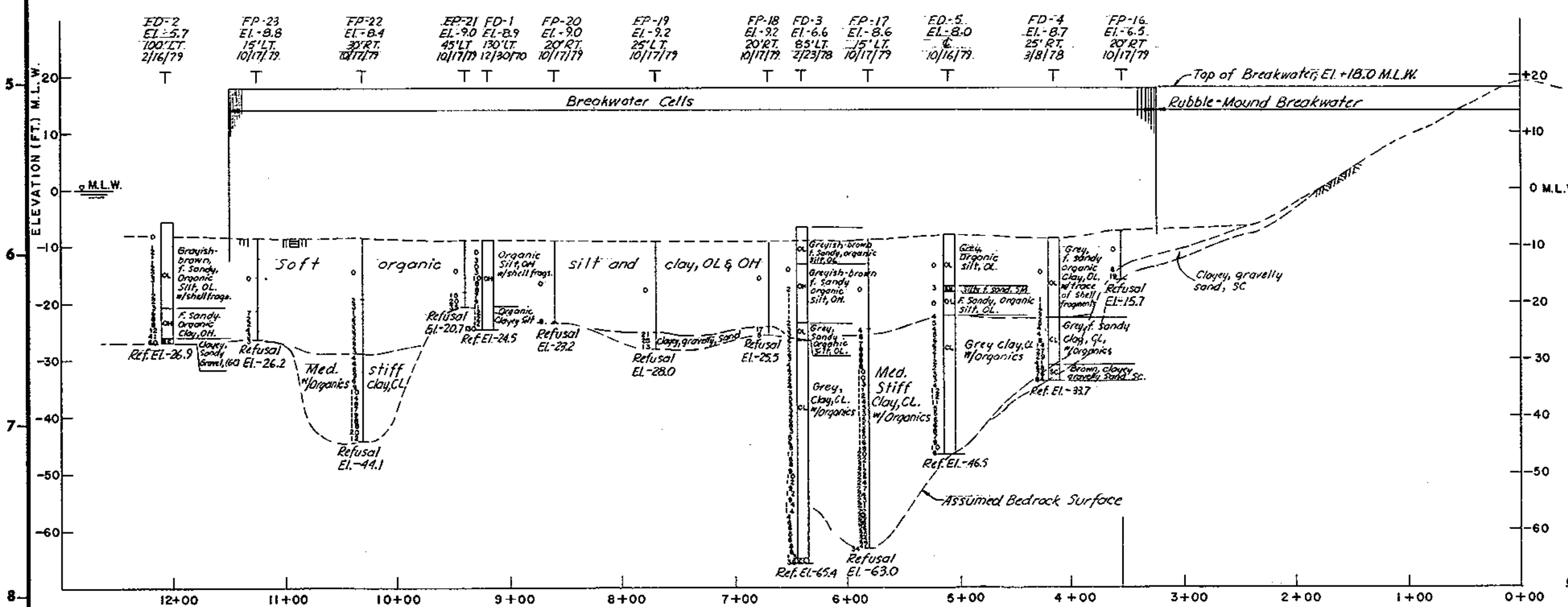
CORPS OF ENGINEERS | U. S. ARMY



L.L., P.L., & Wn Vs DEPTH



PLASTICITY CHART



PROFILE AT ℄ OF BREAKWATER

SCALE: HORIZ 1" = 50' VERT 1" = 10'

NOTES:

Probes (FP-) Drove AW Rods w/300 LB Hammer - 18" Drop.
Borings (FD-) Drove 1½"x 5' Solid Spoon w/300 LB Hammer - 18" Drop.
Number to left of hole represents blows per ft.
J-2 Sample Number

GRAPHIC SCALES

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

JONESPORT HARBOR MAINE
NAVIGATION IMPROVEMENTS DESIGN MEMO
SOIL PROFILE AND SELECTED TEST DATA

DATE DEC. 1979

SCALE AS SHOWN | SPEC. NO. | DRAWING NUMBER | SHEET

PLATE NO. 6

SOIL TESTS RESULTS

EXPL. NO.	TOP ELEV. FT. (M.L.W)	SAMPLE NO.	DEPTH FT.	SOIL SYMBOL	MECHANICAL ANALYSIS GRAVEL %	SAND %	FINES %	D_{10} mm.	ATT. LIMITS LL	PL	SPECIFIC GRAVITY	NAT. WATER CONTENT % DRY WT TOTAL	-NO4	COMPACTION DATA STND. AASHO OPT. WATER % DRY WT	MAX. DRY DENS. LBS/CU FT	* PVD LBS/CU FT	NAT. DRY DENSITY LBS/CU FT TOTAL	-NO4	OTHER TESTS SHEAR	CONSOL.	PERM.	Percent Organics
FD-2	-5.7	J-2	5-10	OL					41	28	2.67	53										0.70
		J-4R	10-15	OL								67										
		J-6R	15-20	OH					88	34	2.66	72										3.95
FD-3	-6.6	J-6R	10-15	OH					103	43	2.68	103										5.09
		J-10R	20-25	CL					36	18	2.74	27										0.84
		J-14R	30-35	CL								31										
		J-16R	35-40	CL								27										
		J-18R	40-45	CL					37	18	2.75	29										3.04
		J-20R	45-50	CL								28										
		J-21R	50-55	CL					31	16	2.74	23										0.49
FD-4	-8.7	J-3R	5-10	OL					39	24	2.66	63										2.72
		J-8R	15-20	CL					33	17	2.71	27										0.71
FD-5	-8.0	J-10R	20-25	CL	0	3	97	<0.001	37	18	2.70	28										0.76
									35*	19*												

*oven-dry sample

PLATE NO. 7

NED FORM JUL 63 510   * PROVIDENCE VIBRATED DENSITY TEST

Jonesport Harbor, Maine

NAVIGATION IMPROVEMENTS
JONESPORT HARBOR, MAINE
DESIGN MEMORANDUM
BREAKWATER, CHANNEL AND ANCHORAGES

INDEX - APPENDICES

APPENDIX A

BREAKWATER DESIGN FACTORS AND ANALYSIS

NAVIGATION IMPROVEMENTS
JONESPORT HARBOR, MAINE
DESIGN MEMORANDUM
BREAKWATER, CHANNEL AND ANCHORAGES

APPENDIX A
BREAKWATER DESIGN FACTORS AND ANALYSIS

1. Statement of the Problem. The principal difficulties attending navigation in Jonesport Harbor stem from the exposed position of the harbor to storm waves generated by winds from the east through the south to the south-southwest and from the lack of a naturally sheltered anchorage for the present and prospective fishing fleet. The largest waves occur during easterly storms. These waves pass to the west through Moosabec Reach. Waves from southerly directions are refracted around islands on the south side of the Reach and approach the Jonesport shoreline from a variety of directions. With the exception of Sawyer Cove, the entire shoreline is exposed. Boats and lobster cars moored in the deep water of the Reach break loose and drift onto the rocky coast. Severe damage occurs to boats during the winter from ice packs drifting through Moosabec Reach on the flood and ebb tides. There have been several instances where ice floes have carried boats away, necessitating rescue by a U.S. Coast Guard icebreaker. This exposure has discouraged local fishermen from developing any adequate terminals from which to operate.

2. Design Criteria. The proposed navigational improvements consisting of a breakwater across the entrance to Sawyer Cove and a dredged anchorage within the cove, are designed to provide a protected harbor of sufficient size to accommodate the present and prospective fishing fleet. The present size of the local fishing fleet, exclusive of row boats and outboards, which would probably be hauled out during severe storms, is about 60 vessels ranging in length from 25 to 65 feet. Twelve new boats in the 60-foot trawler category and two new draggers about 110 feet in length are expected to be added to the fleet during the estimated 50-year project life. The location of the project within the cove lends itself to possible further enlargement to provide added accommodations for any unanticipated increase in boating activities. Anchorage and docking areas included in the project plan should be adequately sheltered to a degree which would limit wave heights therein to less than 2 feet.

3. Tides. Tides in the project area are semi-diurnal. Mean and spring tide ranges in Jonesport Harbor vary from 11.5 feet to 13.2 feet, respectively.

4. Tidal Currents. Tidal currents at Moosabec Reach, east end, as given by the National Ocean Survey "Tidal Current Tables for 1979, Atlantic Coast of North America," follow:

TABLE A-1

WIND SPEED AND DIRECTION (OCTOBER 1949 - SEPTEMBER 1964 INCLUSIVE)

PORTLAND, MAINE
NUMBER OF WINDS

Wind Speed (M.P.H.)	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	47 & Over	Total	% Total Duration	Average Speed M.P.H.	Wind Movement Miles	% Total Movement	% Duration per Degree
N	704	3347	4194	2613	515	98	34	4	-	11,509	9.0	10.1	116,364	9.8	0.40
NNE	358	1503	2192	2015	481	106	6	3	-	6,667	5.2	11.3	75,332	6.4	0.23
NE	245	1054	1275	722	197	54	4	-	-	3,551	2.8	10.2	36,134	3.1	0.12
ENE	207	865	1868	873	229	114	37	2	-	3,595	2.8	11.3	40,560	3.4	0.12
E	265	1140	1877	1132	228	118	30	11	4	4,805	3.8	10.9	52,340	4.4	0.17
ESE	258	956	1238	623	112	34	10	-	-	3,231	2.5	8.6	27,842	2.4	0.11
SE	260	909	778	397	71	26	6	4	-	2,451	1.9	8.8	21,488	1.8	0.08
SSE	283	1103	1872	1330	162	84	29	9	1	4,873	3.8	10.7	51,977	4.3	0.17
S	503	2286	3955	3486	504	100	6	3	-	10,843	8.5	11.1	120,565	10.2	0.38
SSW	551	2880	3560	1810	186	30	3	2	-	9,022	7.1	9.2	82,733	7.0	0.32
SW	713	3287	3183	1318	111	16	2	-	-	8,630	6.7	8.5	73,607	6.2	0.30
WSW	824	3636	3512	2142	485	116	12	1	-	10,728	8.4	9.6	102,677	8.7	0.37
W	1124	4631	3371	1824	449	143	12	-	1	11,555	9.0	8.9	102,612	8.6	0.40
WNW	1011	4141	3320	1774	387	74	5	-	-	10,712	8.4	9.0	95,590	8.2	0.37
NW	984	3800	2972	1981	350	58	5	1	-	10,151	7.9	9.0	91,721	7.8	0.40
NNW	726	2902	2874	2245	397	61	2	1	-	9,308	7.2	9.9	90,926	7.7	0.44
CALMS										6,398	5.0				
TOTALS	9016	38,440	41,441	26,285	4867	1232	203	41	6	127,929	100	9.8	1,182,468	100	

Position: Moosabec Reach Lat. $14^{o}32'$, Long. $67^{o}34'$

Current Flood: Average Velocity 1.0 Knot
Max. 1.5 Knots Direction 315^{o} (True)

Current Ebb: Average Velocity 1.0 Knot
Max. 1.5 Knots Direction 260^{o} (True)

5. Winds. U.S. Weather Bureau wind records at Portland, Maine, weather station located about 190 miles southwest of Jonesport Harbor, were obtained for the period 1949 to 1964. Available limited records of wind speed and direction experienced at Eastport during this same period agree with the Portland data. A tabulation showing wind speeds and directions at Portland, Maine is shown on Table A-1.

It is considered that winds prevailing at Jonesport are quite similar to those at Portland and Eastport. The records of these stations indicate that the prevailing winds are westerly. In the winter (November to March), the combination of icelandic low pressure and continental high pressure systems cause winds to blow from the west-to-north direction; from spring to fall (April to October) these two systems weaken allowing the Azores-Bermuda high pressure system to dominate the area by August when southwesterly winds predominate in the region. Records indicate that gale force winds greater than 34 knots occur during the winter months when the winds are from a northerly direction. These records also show that winds of storm intensity at Jonesport (winds in excess of 25 miles per hour) occur slightly less than 5% of the time. The Portland storm wind records show that 31% of such winds are from the northeast quadrant, 25% from the southeast, 20% from the southwest and 24% from the northwest.

The proposed breakwater site is exposed principally to waves generated by storm winds approaching from the east clockwise through the south to the south-southwest. A record of such winds, showing duration of hours for the period October 1949 - September 1964 at Portland is shown in Table A-2 as follows:

TABLE A-2

Duration of Storm Winds (with speeds of 25 m.p.h. or greater) at Portland, from an easterly to a south-southwesterly direction,

for the 15-year period 1949-1964

Wind Speed	Direction E	ESE	SE	SSE	S	SSW	Total Duration Hours	Ave Annual Duration Hours
25-31 mph	118	34	26	84	100	30	392	26.1
32-38 mph	30	10	6	29	6	3	84	5.6
39-46 mph	11	-	4	9	3	2	29	1.9
47 mph & over	4	-	-	1	-	-	5	0.33
TOTALS	163	44	36	123	109	35	510	33.93

Extratropical cyclones caused by cold dry air masses from polar regions and warm moist tropical air masses converging on the region, result in rapid weather changes and wind shifts. These storms, which come from a westerly or southwesterly direction usually occur from September to April. They are often called northeasters because the winds over the coast blow from the northeast through the southeast depending upon the location of the center of the cyclone. Heavy rain or snow accompanied by gale force winds characterize the intensity. One of the worst storms in recent years occurred on February 2, 1976. This storm produced sustained southeasterly winds in excess of 70 miles per hour. Of the 11 tropical storms which have passed through the coastal area during the period of record between 1886 and 1970, four reached hurricane intensity.

BREAKWATER DESIGN ANALYSIS

6. Design Tide. The design tide is the highest tide which is estimated to occur in the project area on an average of once a year. The annual spring tide of 1.7 feet above mean high water or 13.2 feet above mean low water is considered to be the highest tide estimated to occur on an average of once a year and has been selected as the design tide height for design of the breakwater.

7. Design Wave. The height of design wave used is the highest significant wave which could be expected to occur at the breakwater site at the time of design tide. The proposed breakwater site is exposed principally to waves generated by storm winds blowing from the east clockwise through the south to the south-southwest. An analysis was made of the National Ocean Survey Chart 13325 (formerly 1201), which shows Jonesport Harbor and the surrounding islands

forming the south side of Moosabec Reach, and of wind records in the general area as described in paragraph 5 of this Appendix, to determine the height of the design wave. This analysis revealed that waves approaching the breakwater site from the east, east-southeast and the southeast have fetches of 65, 3 and 1 nautical miles, respectively. Computations for waves approaching the entrance to Sawyer Cove from these directions, based on a 45-mile per hour wind speed, result in estimated wave heights of 7, 3, and 2 feet, respectively. Deep ocean waves from the east-southeast to the south are effectively diffracted and refracted by the large islands forming the south side of Moosabec Reach. A 12-foot wave reaching the easterly entrance to the Reach is broken up by islands and submerged ledges so that only a 7-foot high wave will pass into the middle of the Reach. Further refraction and diffraction reduces the significant wave height at Sawyer Cove to 5 feet. Observations by local residents confirm the estimated heights and directions of waves generated within the Reach and at the entrance to Sawyer Cove.

8. Rubble-Mound Breakwater Design.

a. General. The inner 350-foot portion of the breakwater will consist of a rubble-mound section constructed on exposed bedrock at Henry Point and on earth offshore. The ground surface varies in elevation from about -7.0 feet mean low water where it abuts the cells to +18.0 feet above mean low water inshore at Henry Point. The breakwater will be subjected to an unbroken maximum wave height of 5 feet. It will be constructed of a gravel fill core protected by bedding and cover stone. The soft organic silt and the scattered surface boulders in the breakwater foundation will be removed prior to the placement of the gravel fill and stone protection layers. The weight of armor stone has been determined from the U.S. Army Coastal Engineering Research Center (CERC) guide equation, as follows:

$$W = \frac{WrH^3}{K_D(S_r - 1)^3 \cot \theta}$$

Where W = Weight of armor stone in pounds
Wr = Unit weight of armor stone in lbs/ft^3
H = Design wave height at the structure in feet
Sr = Specific gravity of armor stone relative to the water at the structure (Sr = Wr/Ww)
Ww = Unit weight of sea water = 64.0 lbs/ft^3
θ = Angle of structure slope measured from horizontal in degrees
K_D = Stability coefficient that varies primarily with the shape of the armor stone, roughness, and degree of interlocking obtained in placement. A K_D factor of 2.9 for non-breaking waves has been used in this instance.

b. Breakwater Slopes and Stone Sizes. Slopes of 1.0 vertical and 1.5 horizontal for both sides have been selected as being the most economical. The size of armor stone for the breakwater, based on a 5.0-foot wave, slopes of 1 on 1.5, a stone unit weight of 165 lbs/ft^3, and a K_D coefficient of 2.9, results in a stone weighing 1200 pounds, or 0.6 ton. The theoretical armor stone size range, based on values of 0.75W and 1.25W for minimum and maximum sizes, respectively, suggested by the Shore Protection Manual, is 0.45 to 0.75 ton. Economical quarry production, however, would require production of stone ranging in size from 0.5 to 1.0 ton with an average of 0.75 ton. Based on the assumption that the stones are cubical in shape, the stones would measure 2.25 feet on a side. The thickness, therefore, of the slope armor stone on the Moosabec Reach side of the breakwater, based on a two stone thick layer, is 4.5 feet. The bedding stone, 1.5 foot thick, was designed to contain stone sizes ranging from 75 to 150 pounds, with an average size of about 120 pounds, which is about 10 percent the weight (W) computed for the armor stone layer. The core will consist of gravel up to 12 inches in size.

c. Crest width. The width of the crest of the rubble-mound portion of the breakwater is designed for a minimum of 15 feet to facilitate construction and future maintenance of the slopes of the rubble-mound structure by land based equipment. Marine equipment cannot reach the rubble-mound portion due to shallow water depths.

9. Cellular Steel Sheet Pile Breakwater Design.

a. General. The cellular steel sheet pile portion of the breakwater will consist of sixteen 49.34-foot diameter cells and fifteen interlocking diaphragm arcs constructed of PS-28 sheet piling of ASTM A-690 material, Fy = 50 ksi and interlock strength of 8000 psi. All cell sheeting will be driven to refusal or bedrock and filled with sand or sand and gravel to elevation +13.5 ft. mlw and capped with 1.5 feet of bedding stone and 3.0 feet of cover stone to prevent erosion of the sand or sand and gravel by overtopping waves. Unsuitable foundation material will be removed from within the cells to firm soil/bedrock or to elevation - 25 feet mlw, whichever is higher.

The top of the breakwater is elevation +18 feet mlw. Average cell height will be 43 feet, except in two rock depressions at about elevation -44 and -63 feet mlw. With the use of marine type steel, a protective coating on the steel and proper electrical cathodic protection, it is expected that the steel sheet piling would serve for the proposed 50-year project life.

The structure was designed to provide protection for a mean spring tide elevation of +13.2 ft. mlw and a design wave height of 5.0 feet, based on maximum water depth conditions. Analysis was made for all wave and ice forces on the structure including such factors as overturning, sliding, interlock tension, vertical shear within the cell fill material, impact loading and all other structural design values considered critical to cell design, in accordance with EM 1110-2-2906 and the CERC Shore Protection Manual. Typical details and computations are included at the end of this Appendix. The circular cells are self-supporting and can be filled individually thus facilitating construction ease.

b. Loading Conditions. Storm condition governs using a maximum wave height of 8.35 feet with stillwater level at +13.2 feet above mlw. Only hydrodynamic forces contribute to overturning. The hydrostatic forces are in balance.

(1) Wave Characteristics.

(a)	Depth of water at structure, ocean side	22.2 ft.
(b)	Average wave height,	5.0 ft.
(c)	Maximum wave height,	8.35 ft.
(d)	Period	10.0 sec.
(e)	Deep water wave length	512.0 ft.
(f)	Wave length at structure	254.6 ft.
(g)	Stillwater level	+13.2 ft. mlw
(h)	Overtopping	5.3 ft.
(i)	Orbital height above stillwater level	1.7 ft.

(2) Shallow Cell Characteristics.

(a)	Maximum interlock tension	3.33 ~~2.48~~ k/lin.in.
(b)	Tilting factor of safety	2.65
(c)	Sliding factor of safety	4.23
(d)	Vertical shear factor of safety	2.17

(3) Deep Cell Characteristics.

(a)	Maximum interlock tension	3.33 ~~2.48~~ k/lin.in.
(b)	Tilting factor of safety	1.26
(c)	Sliding factor of safety	2.70
(d)	Vertical shear factor of safety	1.93

c. Critical Cell and Arc Dimensions and Characteristics.

(1)	Number of piles in cell	124.0
(2)	Diameter of cell	49.34 ft.
(3)	Y-distance between center of cells	55.19 ft.

(4)	Arc radius	14.33 ft.
(5)	Number of piles in arc	34.0
(6)	Distance to arc radius	7.35 ft.
(7)	Distance between cells	5.85 ft.
(8)	Effective width of cell	43.34 ft.
(9)	Area within cell	1912.0 s.f.
(10)	Area between cells	480.0 s.f.

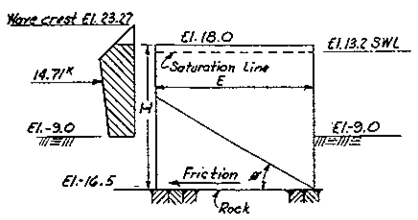
10. Run-up and Top Elevation. Wave run-up on the rubble-mound structure has been determined by use of the Shore Protection Manual Volume II published in 1977 by the U.S. Army CERC, using a 5-foot wave height and a 10 second deep water wave period. The wave run-up on the breakwater would be approximately 5.2 feet. This vertical height when added to the design still water level of +13.2 feet mlw results in an elevation of storm wave run-up at the proposed structure of +18.4 feet mlw. The maximum wave run-up elevation on the steel sheet pile portion of the breakwater was calculated on a similar basis and found to be +23.3 feet mlw. It is concluded however that the top of the breakwater should be set at +18.0 feet above mean low water for the following reasons:

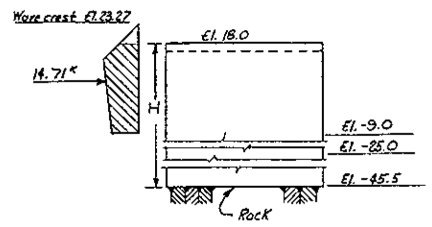
a. Overtopping of the rubble-mound portion by 0.4 feet and of the steel sheet pile portion by about 5 feet would not have a significant effect on the wave action within the protected anchorage and dock area. The volume of water passing over the crest of the structure would reform into a broken wave of less than 2 feet in height within the anchorage area. This height can be tolerated by the type of craft expected to be moored in the anchorages.

b. The occurrence of a 5.0-foot significant design storm wave at the breakwater combined with a design still water level occurrence of once per year would be extremely infrequent.

11. Breakwater Foundation. Reference is made to Section M "GEOLOGY AND SOILS" of the basic report for breakwater foundation conditions and treatment.

2 Incls
Plate No. A-1
Computations





HORIZONTAL SHEAR ANALYSIS	
Tilting resistance of cell fill	619.06'K
Applied forces and overturning moments	14.71K 312.48'K
Tilting resistance of interlock friction	209.07'K
Safety factor against tilting	2.65
Sliding factor of safety	4.23
Maximum interlock tension	3.3 K/lin. in.
VERTICAL SHEAR ANALYSIS	
Driving shear	10.81K
Center shear resistance cell fill	18.65K
Frictional resistance of sheet pile interlock	4.31K
Safety factor against failure	2.12

SHALLOW CELL

HORIZONTAL SHEAR ANALYSIS	
Tilting resistance of cell fill	0.0
Applied forces and overturning moments	14.71K 739.07'K
Tilting resistance of interlock friction	928.2'K
Safety factor against tilting	1.31
Sliding factor of safety	2.7
Maximum interlock tension	3.3 K/lin. in.
VERTICAL SHEAR ANALYSIS	
Driving shear	25.58K
Center shear resistance cell fill	28.05K
Frictional resistance of sheet pile interlock	71.39K
Safety factor against failure	1.85

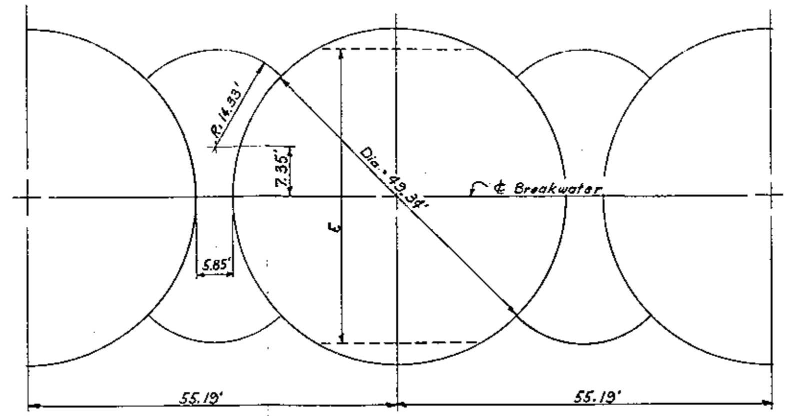
DEEP CELL

Note: All values based on 1 ft. width of section

STORM LOADING CONDITION (CLAPOTIS)

CELLULAR BREAKWATER DESIGN DATA	SHALLOW CELL	DEEP CELL
H = Height of cell	45.5 ft.	63.5 ft.
E = Effective width of cell	43.34 ft.	43.34 ft.
Ka_1 = Coef. active earth press. above El. -25.0	0.333	0.333
Ka_2 = Coef. active earth press. below El. -25.0	N/A	1.0
K_1 = Ratio P_H/P_V on vert. plane above El. -25.0	.6	.6
K_2 = Ratio P_H/P_V on vert. plane below El. -25.0	N/A	0
γW = Unit weight of water	64.2 lbs/cu. ft.	64.2 lbs/cu. ft.
γSAT = Saturated unit weight	135 lbs/cu. ft.	135 lbs./cu. ft.
γSUB_1 = Submerged unit wt. above El. -25.0	75 lbs/cu. ft.	75 lbs./cu. ft.
γSUB_2 = Submerged unit wt. below El. -25.0	N/A	60 lbs/cu. ft.
Ø = Angle of repose cell fill	30.0°	0°-below El. -25.0
tan Ø = Coef. sliding friction	0.577	0
t max = Max. allow. interlock tension (1)	8000#/lin. in.	8000#/lin. in.
N_t, G_s = Factor of safety against tilting	1.25 min.	1.25 min.
SSF = Factor of safety against sliding	1.0 min.	1.0 min.
Kp = Coef. passive earth pressure	1.0	1.0

(1) Note: Use PS 28 steel sheet piling (ASTM A-690) with 90° connecting tees and connecting arcs.

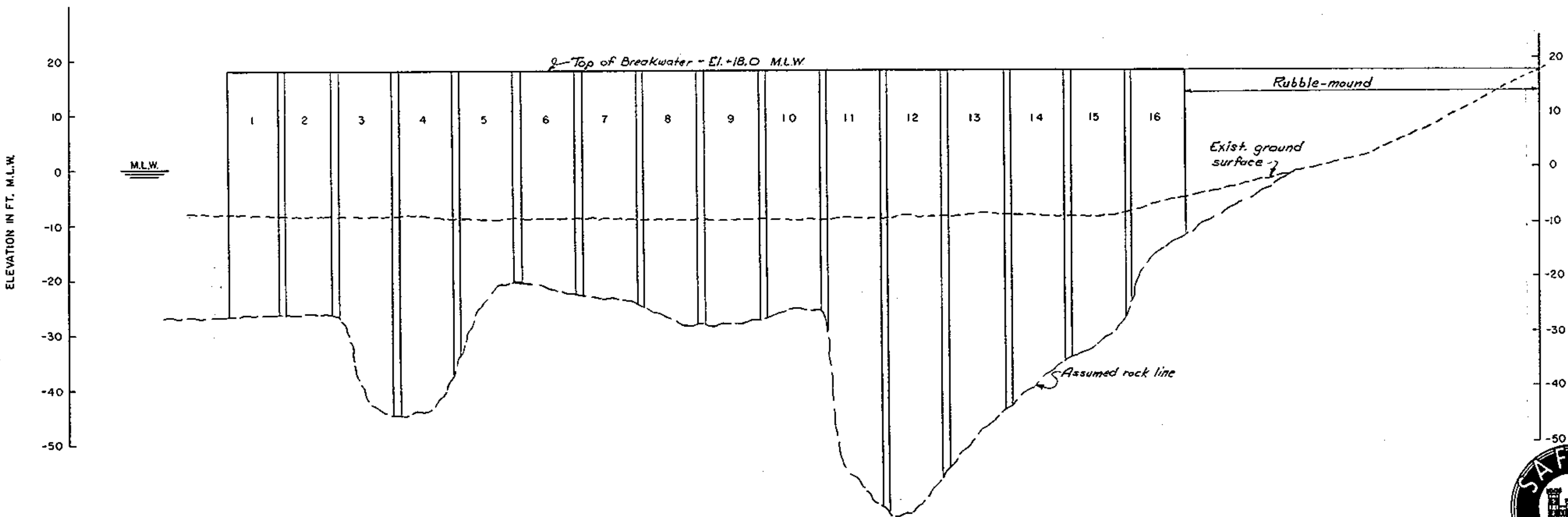


PLAN

CELLULAR BREAKWATER

DESIGN SECTION

SCALE 1" = 10'-0"



BREAKWATER PROFILE

SCALE: HORIZ. 1" = 50'
VERT. 1" = 10'

GRAPHIC SCALES

1" = 10' 10' 0 10' 20'

1" = 50' 50' 0 50' 100'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY W J H | DR. BY R F M | CK. BY

SUBMITTED: CHIEF, SECTION

APPROVAL RECOMMENDED: CHIEF, DESIGN BRANCH

REVIEWED: PROJECT ENGINEER

APPROVAL RECOMMENDED: CHIEF, BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION

JONESPORT HARBOR
MAINE
NAVIGATION IMPROVEMENTS
DESIGN MEMO
STABILITY ANALYSIS

DATE DEC. 1979

SCALE | SPEC. NO.

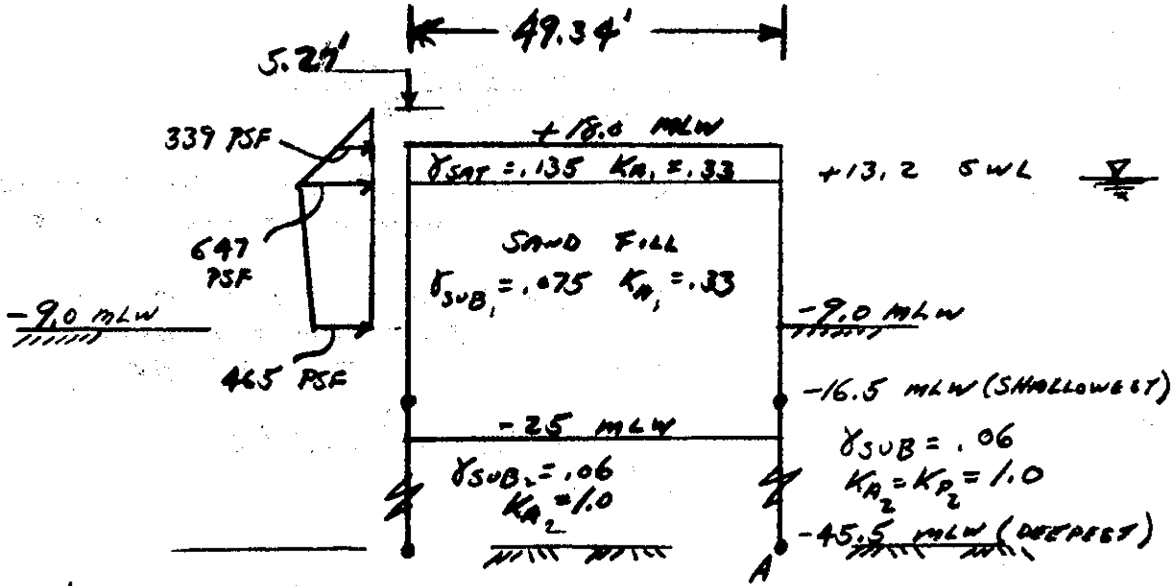
DRAWING NUMBER

SHEET

NED FORM 223
27 Sept 49

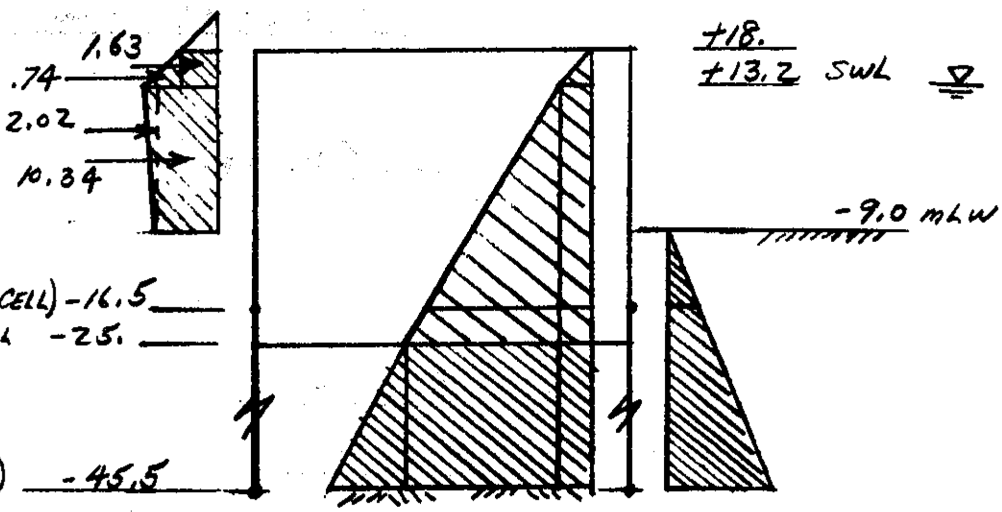
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT Jonesport Harbor Cellular Breakwater
COMPUTATION Cell Stability - PS28 - 90° Tees - 49.34' Diam. Cells - Dredge & Fill Sand -25.
COMPUTED BY WTH CHECKED BY DATE Nov. '79



D = 49.34', Y = 55.19', Z = 5.85, E = 43.34
CELLS TO BE DREDGED TO -25. MLW & SAND FILLED

* SEE P. 5 FOR WAVE COMPS



M@A DUE TO WAVE FORCE

FORCE	ARM		MOMENT	ARM	MOMENT
.339 (4.8) = 1.63	32.1	=	52.32	61.1	99.59
(.647-.339)(4.8)/2 = .74	31.3	=	23.16	60.3	44.62
.465(22.2) = 10.32	18.6	=	191.95	47.6	491.23
(.647-.465)(22.2)/2 = 2.02	22.3	=	45.05	51.3	103.63

TOTALS 14.71^{K} $312.48^{1\text{-}K}$ SHALLOW CELL $739.07^{1\text{-}K}$ DEEP CELL

SUBJECT JONESPORT HARBOR CELLULAR BREAKWATER
COMPUTATION CELL STABILITY - PS28 - 90° TEES - 49.34' DIAM. CELLS
COMPUTED BY WDH CHECKED BY DATE NOV '79

"STORM LOADING CONDITION"

TILTING RESISTANCE DUE TO CELL FILL

(SHALLOW CELL) $\phi = 30°$ $\tan\phi = .58$

$M_R = ac^2\gamma/2 + c^3\gamma/3$ (REF. U.S.S. STEEL SHEET PILING DESIGN MANUAL P.75)

$B = E = 43.34'$
$C = B\tan\phi = 25.14$
$a = H - C = (34.5 - 25.14) = 9.36$

ASSUME γ = SUB. WT. FOR FILL CONSERVATIVELY = .075 KCF

$M_R = 9.36(25.14)^2(.075)/2 + (25.14)^3 .075/3$
$= 221.84 + 397.22$
$= \underline{\underline{619.06}}$ 1-K

(DEEP CELL) $\phi = 0°$ $\tan\phi = 0$
NO TILTING RESISTANCE DUE TO CELL FILL

TILTING RESISTANCE DUE TO INTERLOCK TENSION

(SHALLOW CELL)

$M_1 = P_{INTER.}\ f\ E = 16.08\,(.3)(43.34)$
$= \underline{\underline{209.07}}$

(DEEP CELL)

$M_1 = 71.39(.3)(43.34) = \underline{\underline{928.2}}$

SAFETY FACTOR AGAINST TILTING

(SHALLOW CELL) = $(619.06 + 209.07)/312.48 = \underline{\underline{2.65}}$

(DEEP CELL) = $928.2/739.07 = \underline{\underline{1.26}}$ (W/O PASSIVE RESISTANCE)

$928.2 + \underbrace{1/2(.06)(1)(36.5)^2}_{\text{(PASSIVE)}}/739.07 = \underline{1.31}$ W/ PASSIVE RESISTANCE

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT JONESPORT HARBOR CELLULAR BREAKWATER
COMPUTATION CELL STABILITY - PS28 - 90° TEES - 49.34' DIAM. CELLS
COMPUTED BY MDH CHECKED BY DATE NOV. '79

SHEAR FAILURE ON CENTERLINE OF CELL (VERTICAL SHEAR)

(SHALLOW CELL) $\phi = 30°$

$K = \cos^2\phi / (2 - \cos^2\phi) = .75/1.25 = .6$

$Q = 3M/2E = 3(312.48)/[2(43.34)] = 10.81$

$℄ P = \frac{1}{2}(.135)(.6)(4.8)^2 + .135(.6)(4.8)(29.7) + \frac{1}{2}(.075)(.6)(29.7)^2$
$= .933 + 11.55 + 19.85 = 32.33$

$S_N = P \tan\phi = 18.65$

$P_{INTERLOCK} = \frac{1}{2}(.33)(4.8)^2(.135) + .33(.135)(4.8)(29.7) + \frac{1}{2}(.33)(.075)(29.7)^2 - \frac{1}{2}(.06)(1)(7.5)^2$
$= .51 + 6.35 + 10.91 - 1.69 = 16.08^K$

$S_t = P_{INTER}\, f\, r/L \quad L = Y/2$

$F.S. = [18.65 + .3(16.08)(24.67)(2)/55.19]/10.81 = \underline{2.12} > 1.5$

(DEEP CELL) $\phi = 30°$ TO EL. -25 $\phi = 0°$ TO EL. 45.5 MLW

$Q = 3M/2E = 3(739.07)/2(43.34) = 25.58$

$℄ P = \frac{1}{2}(.135)(4.8)^2(.6) + .135(4.8)(.6)(38.2) + .135(4.8)(20.5)(1)$
$+ \frac{1}{2}(.075)(.6)(38.2)^2 + .075(38.2)(20.5)(1) + \frac{1}{2}(.06)(20.5)^2(1)$
$= .93 + 14.85 + 13.28 + 32.83 + 58.73 + 12.61$
$= 133.24$

$S_N = P \tan\phi$
$= .93 + 14.85 + 32.83).577 = 28.05$

$P_{INTERLOCK} = \frac{1}{2}(.33)(4.8)^2(.135) + .33(.135)(4.8)(38.2) + \frac{1}{2}(.33)(.075)(38.2)^2 + .135(4.8)(1)(20.5) + .075(38.2)(1)(20.5)$
$+ \frac{1}{2}(.06)(1)(20.5)^2 - \frac{1}{2}(.06)(1)(36.5)^2$
$= .51 + 8.17 + 18.06 + 13.28 + 58.73 + 12.6 - 39.97$
$= 71.39 \quad S_t = P_{INTER}\, f\, r/L$

$L = Y/2$

$F.S. = [28.05 + 71.39(.3)(24.67)(2)/55.19]/25.58$
$= \underline{1.85} > 1.5$ O.K.

SLIDING FACTOR OF SAFETY

(SHALLOW CELL)

WT. OF CELL FILL $= 4.8(43.34)(.135) + 29.7(43.34)(.075)$
$= 28.08 + 96.54$
$= 124.6^K$

SLIDING F.S. $= 124.6(.5)/14.71$
$= \underline{\underline{4.23}}$ FLAT PLANE OF SLIDING

(DEEP CELL)
RELY ON PASSIVE RESISTANCE ALONE

S.F. $= 39.97/14.71 = \underline{\underline{2.7}}$

CRITICAL SLIDING CELL WOULD BE ROCK JUST BELOW -25 (DEPTH OF SAND FILL)

AT -26. $P_p = (17)^2(.06)(1)(1/2) = 8.7^K > 14.71$

$14.71 - 8.7 = 6.04^K$

TO GET SLIDING F.S. OF 1.5 NEED COEFFICIENT OF FRICTION OF

$1.5(6.04)/(\sim 125) = .07$

INTERLOCK TENSION MAXIMUM
SAT. EARTH TO MLW; SUB. EARTH BELOW MLW
MAX. INTERLOCK AT DREDGE LINE EL. -9.0
$\theta = 45°$

$t = [.135(18) + .075(9)].33 = \underline{1.025}^{K/1}$

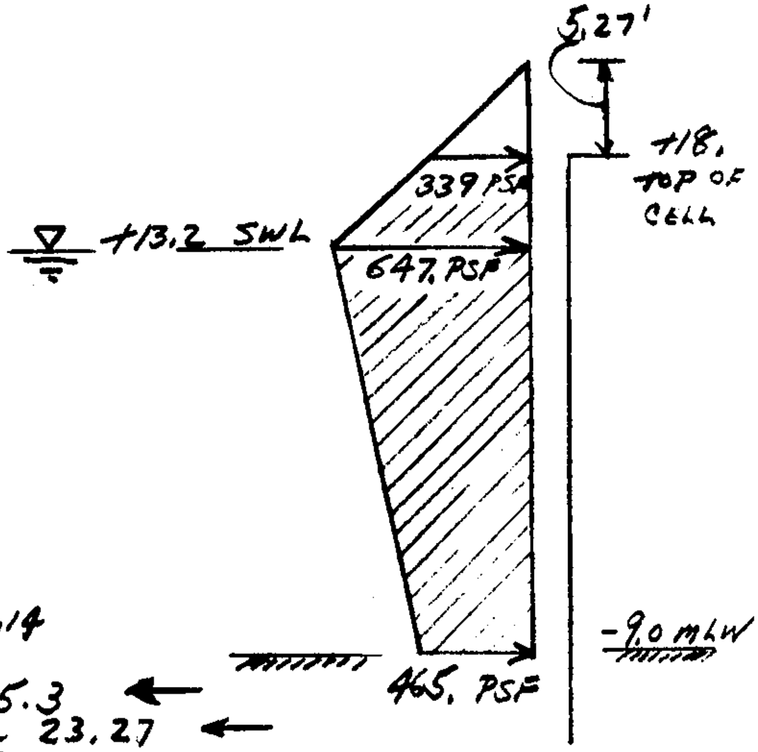
$tr/12 = 1.025(24.67)/12 = 2.11\ ^K/$LIN. IN. = MAX. INTERLOCK IN MAIN CELL

$t_{MAX} = tL \sec\theta = 1.025(27.575)1.414/12$
$L = Y/2$
$= \underline{\underline{3.33}}\ ^K/$LIN. IN. = MAX. INTERLOCK AT CONNECTING TEE

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT JONESPORT HARBOR CELLULAR BREAKWATER
COMPUTATION WAVE LOADING (CLAPOTIS)
COMPUTED BY [illegible] CHECKED BY DATE NOV. '79



STORM CONDITION (CLAPOTIS)

$H = 5.0'$

$H_s = 1.67 \times 5 = 8.35'$

$SWL = +13.2'$

$T = 10$ SEC.

$L_0 = 5.12(10)^2 = 512'$

$d = 13.2 + 9.0 = 22.2$

$d/L_0 = .04336$

$d/L = .08667$ (P. D-18)*

$L = 256.14$

$\coth 2\pi d/L = 2.01449$

$\cosh$ " $= 1.15198$

$\tanh$ " $= .49642$

$h_0 = \pi(8.35)^2(2.01449)/256.14$

$= 1.72$

$P_1 = 64.2(8.35)/1.152 = 465.3$ ←

CREST EL. $= 13.2 + 1.72 + 8.35 = 23.27$ ←

$P_{SWL} = (1.72 + 8.35)64.2 = 647.$ PSF ←

* SHORE PROTECTION MANUAL

APPENDIX B

DERIVATION OF AVERAGE ANNUAL BENEFITS

NAVIGATION IMPROVEMENTS
JONESPORT HARBOR, MAINE
DESIGN MEMORANDUM
BREAKWATER, CHANNEL AND ANCHORAGES

APPENDIX B
DERIVATION OF AVERAGE ANNUAL BENEFITS

1. Computation of Annual Benefits - Fishing

a. General: The following analyses utilize a project life of 50 years and a discount rate of 7-1/8%, the rate in effect for FY 1980.

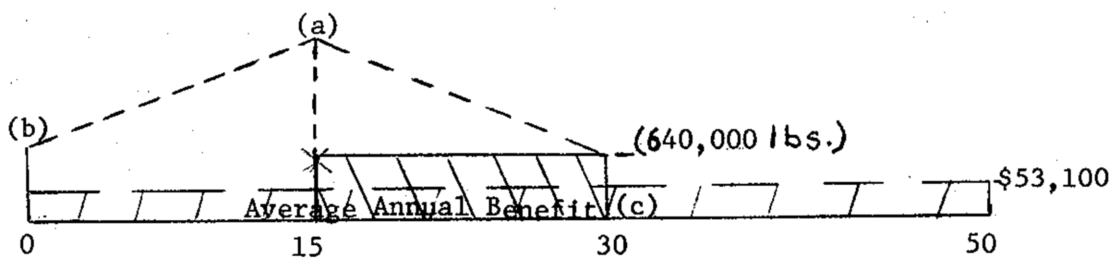
b. Benefit Computation:

(1) Lobster.

Increased catch: 150,000 lbs
Ex-vessel price: $2.00 per lb.
Operating expense: 20%
Annual benefit: 150,000 x $2.00 x .80 = $240,000

(2) Shrimp.

Increased catch: 640,000 lbs (project year 15-30 only)
Ex-vessel price: $.70 per lb.
Operating expense: 50%
Annual benefit:



(a) Present worth at project year 15
640,000 lbs x 9.03643 (pres. worth uniform annuity series for 15 years) x $.70 x .50 = $2,024,200

(b) Present worth at project year 0
$2,024,200 x .35615 (pres. worth lump sum 15 years) = $720,900

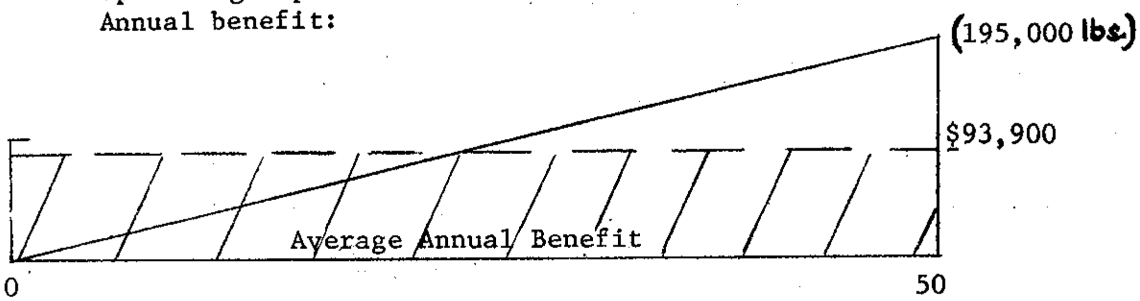
(c) Average annual benefit
$720,900 x .07360 (capital recovery factor) = $53,100

(3) Groundfish.

(a) Cod and Flounder
Increased catch: 900,000 lbs. cod
100,000 lbs. flounder
Ex-vessel price: \$.17 per lb. cod
.35 per lb. flounder
Operating expense: 50%
Annual benefit: (900,000 x \$.17 + 100,000 x \$.35)
x .50 = \$94,000

(b) Other
Increased catch: 625,000 lbs. pollock
385,000 lbs. hake
125,000 lbs. haddock
Ex-vessel price: \$.16 per lb. (pollock)
.13 per lb. (hake)
.40 per lb. (haddock)
Operating expense: 50%
Annual benefit: (625,000 x \$.16 + 385,000 x
.13 + 125,000 x .40).50 = \$100,000

(4) Scallops.
Increased catch: uniform increase each year with total
catch of 195,000 lbs in project year 50
Ex-vessel price: \$3.00
Operating expense: 40%
Annual benefit:



195,000 lbs x .26762 (average annual equivalent)
x \$3.00 x .60 = \$93,900

(5) Herring.
Increased catch: 300,000 lbs.
Ex-vessel price: \$.09 per lb.
Operating expense: 20%
Annual benefit: 300,000 lbs x \$.09 x .80 = \$21,600

(6) Dogfish.
Increased catch: 1,500,000 lbs.
Ex-vessel price: $.07 per lb.
Operating expense: 50%
Annual benefit: 1,500,000 lbs. x $.07 x .50 = $52,500

JONESPORT HARBOR - COMPUTATION OF EMPLOYMENT BENEFITS

Labor Category	Avg. No. of Men Required	Men-hours Required for Project Const. (1)	Hourly Avg. Wage (2)	Total Labor Costs	% Paid to Workers Obtained from ARA Force	Wages Paid to Locally Unemployed or Underemployed
Skilled	8	21,120	11.00	$232,320	30	$69,696
Semi-Skilled	4	10,560	10.33	109,085	35	38,179
Unskilled	14	36,960	7.75	286,440	45	128,898
Totals	26	68,640		$627,845		$236,773

(1) Each worker assumed to work 1,760 hours per year for construction period of 1.5 years.
(2) Based on wages rates obtained from U.S. Department of Labor.

Annual Employment Benefit - Initial Construction:

$236,773 x .07360 (CRF. 7-1/8% 50 yr. life) = $17,400

APPENDIX C

LETTERS OF COMMENT

Tel. 497-2936

Town of Jonesport

OFFICE OF THE SELECTMEN

Jonesport, Maine 04649

November 16, 1979

Max B. Scheider
Colonel, Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02154

Dear Colonel Scheider:

Re: NEDED-D
Letter dated 8 November, 1979

Please be advised that the Town of Jonesport has indicated its acceptance of the proposed navigation improvement and is willing and able to meet the requirements (as outlined in referenced letter) of local cooperation at the appropriate time.

Sincerely,

Gloria K. Feeney

Gloria K. Feeney
First Selectwoman
TOWN OF JONESPORT

Town of Jonesport

OFFICE OF THE SELECTMEN

Jonesport, Maine 04649

April 7, 1978

Division Engineer
U.S. Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts

Dear Sir:

As requested, the Selectmen of the Town of Jonesport have searched for a land area suitable for a dredge spoil site for the proposed Jonesport Harbor Project. It is impossible to locate one within the prescribed distance.

It appears that a good possibility for a spoil site is the section on the southern side of Moosabec Reach between Pig Island and Big Sheep Island. There is a maximum depth of eight feet (8') with many half-tide ledges. If the spoil were to be deposited here, it could provide a substantial clam and worm flat area that could be very valuable as an economic resource.

The location is only one (1) mile from the proposed dredged area and should reduce the cost of transporting "spoil". There are no adverse aspects to this site in relation to the fisheries as there are no fisheries in this area.

We hope this meets with your approval. If we can be of further assistance, please feel free to contact us.

APR 10 1978

Sincerely,

Harry S. Fish (f)

Harry S. Fish, Chairman
Board of Selectmen
TOWN OF JONESPORT

HSF/f

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
AUGUSTA, MAINE 04330

STAFF ORDER
IN THE MATTER OF

U. S. ARMY CORPS OF ENGINEERS	) Water Quality Certification
Jonesport, Maine, Washington County	)
NAVIGATION IMPROVEMENTS, JONESPORT HARBOR	) SUMMARY, FINDINGS OF FACT AND ORDER
#08-6316-29250	)

After review of the request and related materials submitted by the applicant under provisions of Section 401 of P.L. 92-500, the Federal Water Pollution Control Act Amendments of 1972, the Department finds that:

1. The Applicant proposes the following improvements in Jonesport Harbor:

   A. A 100 foot wide, 8 foot deep entrance channel leading from deep water in Moosabec Reach into Sawyer Cove.

   B. Two anchorages within the cove of 9 acres, 6 feet deep and 6 acres, 8 feet deep.

   C. A rubble mound and cellular sheet steel pile breakwater extending from Henry Point southwest for a distance of 350 feet, then west across the entrance of Sawyer Cove an additional 850 feet. These activities will result in 77,000 cubic yards of dredging spoils and 70,000 cubic yards of fill material. Dredge spoils will be disposed of in a shoal area between Pig and Big Sheep Islands.

2. Water Quality Standards will be adversely affected during the construction stages only.

THEREFORE, the Department orders that this project be granted certification that there is reasonable assurance that the activity will not violate applicable Water Quality Standards, subject to the following Conditions:

1. This certification is conditional upon the applicant's continual compliance with all laws, statutes and regulations of the State of Maine, its agencies, municipalities or quasi-municipal organizations relating to the enhancement and protection of the environment.

DONE AND DATED AT AUGUSTA, MAINE, THIS 16TH DAY OF NOVEMBER, 1979

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY: H E Warren

Henry E. Warren, Commissioner

PLEASE NOTE ATTACHED SHEET FOR APPEAL PROCEDURES. . . . .

State of Maine
Executive Department
State Planning Office
State House Station 38
184 State Street, Augusta, Maine, 04333

JOSEPH E. BRENNAN
GOVERNOR

ALLEN G. PEASE
STATE PLANNING DIRECTOR

TEL. (207) 289-326
RESOURCES PLANNING: 289-318

November 9, 1979

New England Division
Corps of Engineers
Att: Max B. Scheider, Colonel
424 Trapelo Road
Waltham, MA 02154

Re: Navigation Improvement, Jonesport Harbor, Jonesport, Maine

Dear Colonel Scheider:

The Corps of Engineers proposes the following improvements in Jonesport Harbor:

1. A 100 foot wide, 8 foot deep entrance channel leading from deep water in Moosabec Reach into Sawyer Cove.

2. Two anchorages within the cove of 9 acres, 6 feet deep and 6 acres, 8 feet deep.

3. A rubble mound and cellular sheet steel pile breakwater extending from Henry Point southwest for a distance of 350 feet, then west across the entrance of Sawyer Cove an additional 850 feet.

These activities will result in 77,000 cubic yards of dredging spoils and 70,000 cubic yards of fill material. Dredge spoils will be disposed of in a shoal area between Pig and Big Sheep Islands. While this area does provide suitable habitat for lobster, local officials indicate that there is no commercial harvesting of marine resources in this area.

The Section 404 Evaluation dated June 1979 indicates that dredging and disposal activities will be coordinated with appropriate state and federal agencies to avoid interference with fish spawning cycles and to minimize interference with migration patterns. At this time, the dates of these activities are unknown.

Both the Department of Environmental Protection and Department of Marine Resources have reviewed the proposed improvements and make the following comments:

Department of Environmental Protection: Dates for construction and disposal activities should be reviewed for interference with marine life prior to work being done.

Department of Marine Resources: The areas of construction and disposal as well as adjacent shellfishing areas should be monitored for water quality and resource quality to insure that contaminated shellfish are not harvested. A more detailed letter will be forwarded under separate cover.

Based on the comments from Department of Marine Resources and Department of Environmental Protection, the State Planning Office concludes that navigation improvements to Jonesport Harbor will be consistent with Maine's Coastal Program provided that dates for construction and disposal are reviewed and approved by Department of Marine Resources and Department of Environmental Protection and that a monitoring program designed to prevent the harvesting of contaminated shellfish is reviewed and approved by Department of Marine Resources and implemented by the Corps.

Sincerely,

ALLEN PEASE
Director

AP:TB/mf

STATE OF MAINE

DEPARTMENT OF TRANSPORTATION

TRANSPORTATION BUILDING AUGUSTA, MAINE 04333

ROGER L. MALLAR
Commissioner

October 29, 1979

Max B. Scheider
Colonel, Corps of Engineers
Division Engineer
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Scheider:

The following statement is in response to the announcement of a public meeting on navigation improvements to Jonesport Harbor, Maine to be held Tuesday, October 30, 1979.

The Maine Department of Transportation in conjunction with the Maine Department of Marine Resources and the State Planning Office recently completed a fish pier needs study. This study indicates that the major fishing activity along the maine coast occurs at some 15 ports. The Jonesport-Beals area is one of the 15 major fishing ports in the State of Maine. The study revealed and local municipal officials and fishermen agree that there is a need for a public commercial fishing facility.

At the present time, there is no sheltered area where a public commercial fishing facility could be located in the Jonesport-Beals area. The proposed Breakwater should provide the protection needed and allow planning to proceed for construction of a much needed commercial fishing facility.

The Maine Department of Transportation supports the proposed project and requests that this be considered a high priority project.

Very truly yours,

MAINE DEPARTMENT OF TRANSPORTATION
Bureau of Planning

William F. Fernald, Director
Transportation Services Division

WFF:JC:plb
cc: Mr. Harry Fish, Jonesport Town Office

IAL O. LOOK, COMMISSIONER

STATE OF MAINE
DEPARTMENT OF MARINE RESOURCES
FISHERIES RESEARCH STATION
WEST BOOTHBAY HARBOR, MAINE 04575

April 11, 1978

Re: NEDED-D

Joe B. Fryar
Chief, Engineering Division
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Fryar:

I have discussed at length with various staff members of the Department of Marine Resources the possible creation of clam flats using dredge spoil from the Jonesport Harbor Navigation Improvement Project. We have no objections to the suggested site. We regard this as a worthwhile experiment for the use of this type of dredge spoil and it is much preferred to ocean disposal. We would like to encourage this project.

Sincerely yours,

John W Hurst Jr.

John W. Hurst, Jr.
Marine Resources Scientist

JWH:PC

cc: Vaughn Anthony, Director of Research (DMR)
Harmon Guptill, NED Chief Nav. & B.E.

STATE OF MAINE
Department of Environmental Protection

MAIN OFFICE: RAY BUILDING, HOSPITAL STREET, AUGUSTA
MAIL ADDRESS: STATE HOUSE, AUGUSTA 04333

Henry E. Warren
[redacted]
COMMISSIONER
289-2811

IINISTRATIVE SERVICES:
89-2691

EAUS:

QUALITY CONTROL
89-2437

D QUALITY CONTROL
89-2111

ER QUALITY CONTROL
89-2591
ABORATORY SERVICES
89-3866
IL POLLUTION CONTROL
89-2591

IONAL OFFICES:

ENTRAL STREET
GOR 04401
6746

CONGRESS STREET
TLAND 04101
6587

MAIN STREET
SQUE ISLE 04769
3737

POLLUTION CONTROL
OMMERCIAL STREET
TLAND
5491
SPILL REPORTS ONLY
L FREE) 1-800-482-0777

ENS' ENVIRONMENTAL
STANCE SERVICE
2691
L FREE) 1-800-452-1942

December 22, 1977

Mr. Joe B. Fryar, Chief
Engineering Division
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Dear Mr. Fryar:

The Department of Environmental Protection staff reviewed the Jonesport project proposed in your December 6, 1977 letter and has the following comments:

1. The project will require a Maine Coastal Wetlands Permit if the applicant is other than a Federal agency.

2. Impact on water quality should be minimal and equilibrium reached within one year of the dredging operation.

3. The Department of Environmental Protection Biological Services staff feels that the use of spoils to construct a productive shell fishery has a more positive impact than ocean dumping or land disposal.

If you have any questions, please contact me at (207) 289-2591.

Sincerely,

Stephen W. Groves

Stephen W. Groves, Director
Bureau of Water Quality Control

SWG:aw

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
P. O. Box 1518
Concord, New Hampshire 03301

April 5, 1978

Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This planning aid report is designed to assist you in your planning efforts for Jonesport Harbor Navigation Project, Jonesport, Maine. As a result of our February 23, 1978, meeting on this project with members of your staff, Maine Department of Marine Resources and the Environmental Project Agency, we wish to make the following comments.

We understand the problems associated with trying to find a suitable spoil site for any navigation project. Jonesport presents a particularly difficult problem because discriminate or indiscriminate ocean dumping could cause major adverse environmental impacts on the marine resources in the area. Therefore, we feel all possibilities for on-land disposal must be exhausted before other action is contemplated.

We would like to support the idea of trying to create a shellfish area, possibly east of Pig Island Gut. However, there is much information which needs to be gathered as baseline data before we could approve or recommend any such activity.

Therefore, we feel it is necessary to not only conduct a detailed sounding survey, as suggested at the meeting, but also the following: a detailed benthic assessment, observations on seasonal movements of finfish and lobster, basic current and tidal studies in the proposed dump site, and sediment composition analysis of the spoil in Sawyer Cove. We would also suggest that alternative areas be investigated for possible use, depending on the results of the proposed studies.

We will be available for consultation on these studies and await your response.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

NEDED-D 19 April 1978

Mr. Gordon E. Beckett
Supervisor
Ecological Services
U.S. Fish and Wildlife Service
Department of the Interior
P.O. Box 1518
Concord, New Hampshire 03301

Dear Mr. Beckett:

Reference is made to your planning letter dated 5 April 1978 concerning the Jonesport Harbor, Maine navigation improvement project. I would like to review with you the recent coordination meetings held on this project and the results of the meetings.

Last year meetings were held with local officials of Jonesport in an attempt to locate suitable onshore disposal areas, in order to complete the design and construction of the project at the earliest possible date. However, town officials have been unsuccessful in locating any sites which would be physically or economically within reach of the dredging site. Inclosed is a copy of their most recent letter suggesting the use of the area under present consideration east of Pig Island.

The Maine Department of Marine Resources has shown an interest in development of a clam flat at the above site. They requested that studies be made to determine the stability of disposed material and whether it would stay in place. After careful consideration it has been decided by this office that the funding allotted to the navigation improvement project does not permit a detailed investigation of the disposal site to assure that a clam flat could be developed. The Maine Department of Marine Resources was informed of this decision by letter dated 28 February 1978. In the letter it was requested that this site be committed for disposal of the dredged material, to develop an experimental clam flat.

NEDED-D 19 April 1978
Mr. Gordon E. Beckett

Funds to perform a hydrographic survey of the site cannot be expended without a definite agreement that it would be used for disposal. Mr. John Hurst, Director of the Marine Resource Research Station, has agreed to this request by letter dated 11 April 1978, copy inclosed. An earlier positive response was received from Maine Department of Environmental Protection dated 11 December 1977, copy inclosed.

Based on John Hurst's letter, we can now conduct a hydrographic survey of the disposal site and all possible approach routes from the dredging project. In addition, environmental samples of the disposal site will be obtained for use in preparing a supplement to the Environmental Impact Statement. The time table for completion of processing the Supplemental Environmental Impact Statement is approximately one year. Your suggestion for long-term biological investigations of the site to aid you in whether to recommend use of the site is inconsistent with the actions of the two state agencies and the local officials who have already approved the use of this site on an experimental basis. Corps and Maine diver/biologists will be reviewing the site hopefully by the second week in May, and their joint report will be used in the Supplemental Environmental Impact Statement. Physical data acquired by our survey crew will also be included.

Sincerely yours,

JOE B. FRYAR
Chief, Engineering Division

3 Incl
1. Ltr frm Jonesport Selectmen
2. Ltr frm ME Dept. Marine Resources
3. Ltr frm ME Dept. Environmental Protection

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I

J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203

December 18, 1979

Mr. Joe B. Fryar
Chief
Engineering Division
New England Division, Corps of Engineers
U. S. Department of the Army
424 Trapelo Road
Waltham, MA 02154

Dear Mr. Fryar:

This is to confirm our agreements relative to the proposed Navigation Improvements, Jonesport Harbor, Maine as discussed during our meeting on December 12, 1979.

The first item of concern to us was the timing of the disposal of dredged material at the Pig Island disposal site. We now understand that disposal can only occur at periods close to and during high slack tide due to relatively shallow depth at the disposal site. This will reduce to a minimum, the dispersion of fine silts over any adjacent shellfish areas.

We also questioned the suitability of the materials to be dredged for open water disposal based upon the mercury content of the sediments and the lack of material for capping. In examining the Corps mercury content data from 1972 and EPA's data from 1979, it appears that mercury in the range of 0.2 to 1.5 parts per million is common to sediments both within Sawyer Cove (the area to be dredged) and outside of the Cove in clean sediments (Henry Point). Therefore, we do not believe that disposal of the materials from Sawyer Cove at the disposal site will adversely affect or provide any new chance for bioaccumulation of mercury by any organisms which may inhabit or feed in the area of the disposal site. In addition, any potential adverse impacts will be partially mitigated by covering of the 57,000 cubic yards of dredged materials with the 25,000 cubic yards of material to be excavated for placement of sheet piling caissons for the breakwater construction.

With regard to the actual dredging operations it is advisable to monitor turbidity and suspended sediment in the vicinity of the lobster pound on the western side of the harbor entrance during dredging. This will provide information to evaluate the potential for any harmful increases in turbidity within the lobster pound.

Sincerely yours,

Allen J. Ikalainen

Allen J. Ikalainen
Chief, Special Permits Development Section

cc: Edward Wong
EPA, Lexington